DOCUMENT RESUME

ED 134 251 JC 770 090

AUTHOR	Hedinger, Howard E.; Fuqua, Larry Warren
TITLE	Apprentice Education; General Information, Curriculum Guides and Bibliography of Materials for the Establishment, Operation, and Implementation of Classes for Related Instruction.
INSTITUTION	North Carolina State Dept. of Community Colleges, Raleigh.
PUB DATE	Feb 77
NOTE	207p.; Cover title, "Apprenticeship: Related Instruction Manual." Revised edition of ED 017 708
EDRS PRICE	MF-$0.83 HC-$11.37 Plus Postage.
DESCRIPTORS	*Apprenticeships; Bibliographies; College Role; Community Colleges; Course Descriptions; *Curriculum Guides; *Instructional Materials; *Junior Colleges; Off the Job Training; Resource Guides; Skilled Occupations; *Trade and Industrial Education; Vocational Education
IDENTIFIERS	*North Carolina

ABSTRACT

This publication, consisting of four sections, contains information for administrative personnel concerning "related instruction" for Apprentice Education in North Carolina's system of community colleges. Related instruction, required courses designed to teach the apprentice that part of his trade which can best be taught in the classroom, is supplemental to the on-the-job training for specific occupations. Section I contains general information concerning the purposes and operation of apprenticeship programs, and describes the roles of the state Department of Labor, advisory committees, and local institutions in relation to apprentice education. Section II contains suggested curriculum guides and course descriptions for the various trades. These are introduced by descriptions of courses basic to all programs, and then are grouped by broad field--Building Trades, Metal and Plastics, Graphic Arts, Service Trades--and divided by specific occupation. Section III contains a comprehensive list of instructional materials, organized by curriculum and subgrouped by textbooks or self-study/programmed materials, applicable to 24 related instruction programs for apprenticeship education. Section IV contains examples of forms used by the North Carolina Department of Labor in relation to apprentice education. (JDS)

****
* Documents acquired by ERIC include many informal unpublished *
* materials not available from other sources. ERIC makes every effort *
* to obtain the best copy available. Nevertheless, items of marginal *
* reproducibility are often encountered and this affects the quality *
* of the microfiche and hardcopy reproductions ERIC makes available *
* via the ERIC Document Reproduction Service (EDRS). EDRS is not *
* responsible for the quality of the original document. Reproductions *
* supplied by EDRS are the best that can be made from the original. *
****

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

APPRENTICE EDUCATION

GENERAL INFORMATION, CURRICULUM GUIDES
AND BIBLIOGRAPHY OF MATERIALS
For the
Establishment, Operation, and Implementation
of
CLASSES FOR RELATED INSTRUCTION

Prepared by
Howard E. Hedinger
September, 1967

Revised by
Larry Warren Fuqua
February, 1977

DEPARTMENT OF COMMUNITY COLLEGES
PROGRAM DEVELOPMENT
STATE BOARD OF EDUCATION
RALEIGH, NORTH CAROLINA

JC 770 090

By authority of the State Board of Education, North Carolina Administrative Code, Section 4C.0800, the respective institutions and the state department in the North Carolina Community College System are equal opportunity and affirmative action employers.

FOREWARD

This manual was prepared as a "related instruction" guide in apprentice education to be used by administrative personnel in the institutions of the Community College System. Institutions in the Community College System are responsible for "related instruction," required courses supplemental to on-the-job training for specific occupations for apprentices.

We hope that the contents of this publication will help the personnel of the schools in promoting, developing and arranging the varied programs of "related instruction" required by the North Carolina Department of Labor for an apprentice to attain journeyman status. The implementation of effective programs of "related instruction" for apprentices will necessitate the cooperation of many people concerned with or responsible for providing these educational opportunities.

This manual is another aid to the institutions in the pursuit of excellence in a complete range of courses for apprentices trained in North Carolina.

Roger G. Worthington

Roger G. Worthington, Director
Program Development

Ben E. Fountain, Jr.

Ben E. Fountain, Jr.
President

PREFACE

This publication provides information concerning related instruction for Apprentice Education in North Carolina's system of community colleges.

Unskilled production jobs are rapidly becoming fewer and harder to find in this age of rapid technological advancement. In industry jobs are being handled by automatic equipment which requires skilled personnel to maintain. The building industry in our changing economy continues to use new materials and methods. Thus, there are many jobs in the semi-skilled, skilled, and technical areas that provide opportunities for the apprentice to receive practical instruction in classes along with on-the-job training.

Section I includes general information concerning purposes and the operation of apprenticeship programs and sets forth the roles of the Labor Department, advisory committees, and the local institutions.

Section II contains the suggested curriculum offerings for various trades and course descriptions of the subjects.

Section III contains suggested materials for use in the classroom and the learning resource center.

Section IV, which is the Appendix, contains examples of forms used by the North Carolina Department of Labor.

CONTENTS

Page

SECTION I GENERAL INFORMATION 1

The Role of the North Carolina Department of Labor . 5
The Role of Advisory Committees 6
The Role of the Local Institution 7
The Role of the Program Development Division 11

SECTION II SUGGESTED CURRICULUMS . . . . Code

Basic Courses Applied to all Programs 1
Building Trades . . . . W 990
Metal and Plastics . . . . W 991
Graphic Arts . . . . W 992
Service Trades . . . . W 993

SECTION III SUGGESTED BIBLIOGRAPHY FOR APPRENTICESHIP
(Textbooks and Self-study or Programmed Materials)

Air Conditioning 1
Auto Body Repairman 2
Automotive Mechanic 3
Bricklaying and Masonry 6
Carpentry and Cabinetmaking 7
Cement Masonry 11
Diesel Mechanic 12
Electrical Appliance Servicing 13
Electrical Installation 15
Electrical Lineman 16
Farm Machinery 17
Knitting Machine Fixer 19
Machinist 20
Maintenance Mechanic 22
Mechanical Draftsman 23
Metal Fabricator 25
Painting and Decorating 26
Plumbing and Pipefitting 27
Refrigeration 29
Sheet Metal 30
Sewing Machine Repairman 30
Surveying 32
Tool and Diemaker 33
Welding 34

SOURCE LISTING 36

SECTION IV STANDARDS OF APPRENTICE AND SAMPLE FORM USED IN APPRENTICESHIP TRAINING

GENERAL INFORMATION

Purpose of the Apprenticeship Manual

One purpose of this manual is to show briefly how the North Carolina Apprenticeship System operates. The main objective is to present guidelines and suggested related curricula for various occupations each of which require at least 4,000 to 8,000 hours of on-the-job training over the two to four year apprenticeship program. Formal related instruction is recognized by private industry as strengthening the apprenticeship program.

Related Instruction

Related instruction for apprentices is usually at least 144 hours of such instruction annually. The 144 hours of related instruction is recommended as a minimum by the United States Bureau of Apprenticeship. This instruction is supplemental to the on-the-job training for specific occupations. For example, a machinist needs to know how to operate a lathe. Instruction as to the properties of metals to be machined is considered related instruction. Options for instruction include courses at the respective institutions of the North Carolina Community College System. In-plant classroom instruction, correspondence courses and home study are other options. The Apprenticeship Division of the North Carolina Department of Labor has directed that the preferred manner in which related instruction is to be gained will be courses at the respective institutions of the Community College System. If a medium of instruction other than the Community College System is to be pursued, an explanation as to why must be submitted to the Director of Apprenticeship by the field representative of the Department of Labor establishing the particular program.

Objectives of Related Training

The major objective for related instruction for apprentices is to teach the apprentice that part of the technical related information pertaining to his trade which can best be taught in the classroom. Other objectives include the development of ability to apply technical related information, the evolvement of proper attitudes and human relations, and the adjustment to social problems encountered in the world of work. The North Carolina Apprentice Council and Department of Labor have mandated that related training will be required of every apprentice.

General Statutes of North Carolina

The North Carolina Apprenticeship System is administered by the Apprenticeship Division under the North Carolina Department of Labor. Under General Statute 115A, enacted in 1963, the institutions under the Department of Community Colleges have been given the first responsibility for conducting the related training for apprentices in North Carolina.

General Responsibility of the North Carolina Department of Labor

The general function of the North Carolina Department of Labor, Apprenticeship Division, is to promote opportunities for young people to be trained and equipped for gainful employment and good citizenship. The Apprenticeship Division administers the conditions and standards for the on-the-job training in the apprenticeship program. To this end it seeks to ensure that training is adequate and that the employment during training provides reasonable earnings, that the supply of skilled workers relates to employment demands, and that standards for apprenticeship programs are established and enforced.

Why Apprenticeship Education

If a system of "learning by doing," under the guidance of "master craftsmen," has endured for over 4,000 years, the system undoubtedly contains basic qualitative factors for our contemporary society. These factors should be identified clearly and implemented properly in each community where such training is needed.

The institutions in the Community College System can help train the employed apprentice by making available necessary courses, instructors, and classrooms for supplemental related instruction. A concerted effort should be directed toward providing the related instruction by the Community College System.

North Carolina is requiring increasingly greater numbers of highly trained men and women to keep pace with our rapidly changing economy. New demands on the abilities and experience of workers, who need wider training because of changing methods, materials and technology, call for a new look into educational methods. Apprenticeship is an effective means for a young person to develop formal skills. As such, it makes a major contribution to our state's economic growth.

Apprenticeship - A Cooperative Effort

Close and continuing liaison should be maintained at both the state and local levels by the North Carolina Department of Labor, state-staff and field representatives; The North Carolina Department of Community Colleges and the respective institutions in the system; and representatives of business, industry and labor. The close and continuing liaison at the state level should be accomplished by specific individuals in both the Departments of Labor and Community Colleges communicating openly to resolve problems where possible and assuring that necessary information flows to appropriate individuals, i.e., the President of the Community College System and the Commissioner of Labor as well as other key individuals. The Apprenticeship Council also provides a forum for all interested agencies and groups to provide input into the apprenticeship program.

Close and continuing liaison at the local level should be accomplished by apprenticeship field representatives of the North Carolina Department of Labor; extension directors, directors of learning resource centers and other individuals identified by the presidents of the respective institutions in the Community College System; and representatives of business, industry and labor communicating openly and at regular intervals to assure that all interested parties are informed of successes, problem areas and other such information that will benefit the individual apprentices as well as the apprenticeship program.

Close and continuing liaison should also be maintained by state and local individuals responsible for apprenticeship as well as representatives of business, industry and labor.

How the National and State Apprenticeship Groups Operate

- Since the employment and training takes place in the local community, the work of national and state apprenticeship groups is directed toward stimulating interest in training on the part of local employers and employees.

Federal guidelines for apprenticeship are a result of the Fitzgerald Act of 1937. The State guidelines are the result of the North Carolina Volunteer Apprenticeship Act of 1939. Both of these acts provide only guidelines with no mandatory requirements for the establishment of apprenticeship programs. To date the only federal legislation that affects apprenticeship in North Carolina with the exception of regulations from the Veterans Administration, is the Davis-Bacon Act. This act requires that companies with federal contracts maintain an approved apprenticeship program. State regulations affecting apprenticeship programs provide for de-registration of a program for repeated non-compliance to established standards such as failure to enforce mandatory related instruction and deficiencies in the on-the-job training program. The state regulations have originated from the North Carolina Department of Labor and are not the result of legislation from the North Carolina General Assembly.

What Apprenticeship Can Do

Well-planned, properly supervised apprenticeship programs can do these important things:

- Provide an efficient way to train craftsmen to meet present and future needs.
- Provide an adequate supply of skilled tradesmen, in relation to employment opportunities.
- Provide the community with competent craftsmen, skilled in all branches of their trades.
- Increase the individual worker's productivity.
- Give the individual worker a greater sense of security.
- Improve employer-employee relations.
- Provide the versatility necessary to meet changing conditions.
- Attract capable young people to the industry.
- Generally raise skill levels in the industry.

For the young worker entering employment, apprenticeship holds these important values:

- The opportunity to develop his highest skills, creating a greater demand for his services throughout industry, and assuring him of greater economic security and a higher standard of living.
- Further training and education - with pay.
- Assurance of a wage while he is serving his apprenticeship, with regular increases.
- Opportunities for employment and advancement.
- Recognition as a skilled craftsman in his chosen trade.

Who Operates the Apprenticeship Program

- The American apprenticeship system is based on voluntary cooperation among management, labor, industry, government, business, and the school.

- This voluntary cooperation is reflected by using local advisory craft committees to work out suggestions and methods of development and improvement of apprenticeship training within their respective trades or industries.

THE ROLE OF THE NORTH CAROLINA DEPARTMENT OF LABOR

Apprenticeship Division

The Apprenticeship Division of the North Carolina Department of Labor develops, monitors, and supervises apprenticeship training programs.

The primary purposes of the Apprenticeship Act, and the chief aims of the Apprenticeship Council are:

- To assist in the development of better trained workers for the trades.
- To provide orderly procedures for the indenturing and training of apprentices.
- To provide the trainees with practical experience on-the-job.
- To cooperate with the Department of Community Colleges in providing the related training necessary for the trade.

Who Composes the Apprenticeship Council

The Apprenticeship Act provides for the appointment of a State Apprentice Council and a Director of Apprenticeship. The composition of the council is as follows:

- The Commissioner of Labor as chairman
- Three members representing employees
- Three members representing employers
- Director of Apprenticeship acts as secretary
- Two ex-officio members from vocational education

Director of Apprenticeship: Appointment and Duties

- Appointed by the Commissioner of Labor

- Some of the Duties and Functions of the Director
  - Acts as secretary of the Apprenticeship Council
  - Coordinates the activities of the Apprenticeship Representatives assigned to the various districts and counties.
  - Provides accurate data to the Community College System and its respective institutions. This data should include the name, trade and sponsor of each apprentice by county to determine when the need for a particular course exists.
  - Conducts investigations of violations of apprentice agreements including the enforcement of the mandatory related training requirement. The only punitive action that can be taken by the Director of Apprenticeship is the de-registration of the program with the North Carolina Department of Labor. This action usually affects companies financially only if the apprentice is working on a job under Federal contract. The company is then in violation of the Davis-Bacon Act if not in compliance with the mandatory related training and is subject to lose the Federal contract.
  - Approves the transfer of agreements from one employer to another to benefit the apprentice.
  - Keeps records of apprentices (Indentured and Program Agreements cancelled).
  - Advised committees in establishing programs.
  - Issues Certificates of Completion to the apprentices.

THE ROLE OF ADVISORY COMMITTEES

Selection and Appointment of Advisory Committees

- Advisory committees to aid in organizing related instruction classes, though not required, should be established from interested people in the local community.
- Members of these committees should be selected by the local institution from nominees of local employer and employee groups and from local school personnel.
- The same committee may be used as the advisory committee to full-time day curriculum programs or vice versa.

- Each local committee may determine its own organization and time and place of meeting.

- The local apprenticeship advisory committee should be approved by the Apprenticeship Division of the North Carolina Department of Labor if the apprentice is indentured to the committee rather than his employer. The Apprenticeship Division of the North Carolina Department of Labor will recognize an apprenticeship program by a single employer or a group of employers.

Some Duties of a Successful Advisory Committee

- Determine the needs of the area for the specific occupational group.

- Assist the school officials in the selection of instructors from capable journeymen or experienced teachers.

- Assist in determining the quality and comprehensiveness of the on-the-job training and the related instruction.

- Assist in determining if all the job processes listed are performed by journeymen.

- Furnishes the apprentices cards to list work processes and related instruction.

- Attend related instruction classes during the term and hold reviews of the apprentice's progress.

THE ROLE OF THE LOCAL INSTITUTIONS

Who is Responsible for the Related Instruction

- The on-the-job training and work experience of the machinist apprentice, for example, is the responsibility of the employer. The local institution will make available any required related instruction in trade theory, blueprint reading, mechanical drawing, safe working practices, trade mathematics, physics, and other subjects related to the job.

- In most instances, this instruction is given in the local community college or technical institute. In other instances, sponsors develop course materials and conduct their own related instruction programs, use supervised correspondence courses, or seek the services of consultants.

The School Year

- The school year is usually patterned after the calendar of each respective institution, but may vary with local needs.

Minimum Class Load Per Year

- Apprentices should take a minimum of 144 hours of classes each year. Generally they attend four hours per week. Some programs may require six hours per week.
- Courses are 22 hours, 33 hours, 44 hours, 55 hours, and 66 hours in length. Course hours are generally multiples of 11 since the school term is usually 11 weeks in length.

Selection of Courses

- Selection of courses, length of courses and the number of hours of attendance per week should be agreed upon by the employer or advisory committee and personnel from the institution.

Assignment of Apprentice in Related Classes

- New apprentices with similar background and experience may start at the same level.
- All apprentices may not start their related instruction at the same level because of the wide range of individual differences in educational background and experiences.
- Interviews, placement tests, and transcripts from former schools may indicate, that a student may enroll with advanced credit and another may enroll with certain deficiencies.

1. Advanced credit will allow apprentices to fulfill their required hours of related instruction by selecting the elective courses they feel will be of most value to them in their respective trade. Credit may be given for equivalent courses taken at accredited secondary and post-secondary institutions.
2. Deficiencies should be erased by enrolling in preparatory courses offered by the institution, or the apprentice may attend the Learning Resource Center using programmed or self-study materials.

Registration

- Apprentices will register for related classes at a time specified by the personnel of local institutions.

- The apprentice program Codes W990-993 and course title are written on the registration card for local and state records.

- New apprentices may enroll for regular curriculum or extension classes that do not require pre-requisites in any term during the year. They may attend day vocational classes, evening classes and/or learning resource centers.

Fees and Cost of Books

Tuition and Fees for Non-curriculum Extension Instruction: Non-curriculum extension instruction is defined to mean all instruction organized, supervised, or delivered by an instructor or instructors assigned responsibility for the teaching of any defined category of subject matter or special skills to be presented and developed through a single course, or through any discrete training program or training project organized and offered outside the regular curriculums offered by the institution. This definition does not include the self-teaching learning labs.

A registration fee of $5.00 per course charged in lieu of any other tuition or fees for any student enrolling in any non-curricular extension training course the cost of which is supported primarily by State funds appropriated through the State Board of Education except as otherwise specifically provided for in the foregoing paragraph.

Reference - North Carolina Administrative Code
Public Education - Community Colleges (4D.0203-Standard Student
Fees Extension Programs)

- Books, workbooks, notebooks are bought by the apprentice. The employer, in some cases, may buy the books through the school and deduct small amounts from the apprentice's paychecks to be reimbursed.

- Typing and printing of hand out material, tests and the like should be arranged with the extension office of the respective institution.

Attendance

- Apprentices will conform to the attendance guidelines established by the respective institutions.

Dropping a Course

- If it becomes necessary for an apprentice to drop a course, he should report it to the school office immediately.
- The employer and/or the advisory committee should be notified by the institution.

Reports to Employer and Permanent Records

- When a course has been completed by an apprentice, the grade should be filed in the school office on a permanent record.
- Permanent records should verify that the apprentice has completed certain courses.
- The institution should notify the advisory committee and/or employer that the apprentice has satisfactorily completed their required related course work.

Enrollment Requirements

- It is desirable to enroll a minimum of 12 to 20 apprentices in a class for related instruction though this will vary with the respective institutions of the Community College System.
- When there are not sufficient apprentices for classroom instruction, they may be enrolled in elective curriculum courses or extension courses or be assigned programmed materials in the Learning Resource Center.

Discontinued Classes

- In the event that class attendance decreases to a number that makes it undesirable to continue as a group, the remainder of the class may be placed in other related vocational classes. The apprentice may be assigned to programmed studies in the Learning Resource Center. This too will vary with the respective institutions of the Community College System.

THE ROLE OF THE PROGRAM DEVELOPMENT DIVISION

The Program Development Division is interested in the implementation of the related instruction required for the apprenticeship programs. Therefore, the services of the staff are available to help with the implementation of the programs.

Personnel from the Division may assist by developing or providing curriculum guides, outlines of instruction, textbook suggestions, self-study and programmed material suggestions and they will assist and cooperate with local and state advisory committees representing various occupational groups.

Services Available to Local Institutions

Many local school administrators have had little opportunity to become acquainted with apprenticeship programs. If the institution needs assistance in initiating a program and/or selecting instructional materials for conducting the related instruction classes, notify representatives of the state staff, Program Development Division.

Curriculum Guides and Course Outlines

Many curriculum guides and course outlines are available in the Program Development Division, Department of Community Colleges.

- Instruction should be based upon a course outline for the particular subject and should be flexible enough to permit changes as needs arise.
- Related supplemental instruction should be given at the time the apprentice is ready for it and preferably when he is working on the same materials and related skills on-the-job.
- Section II of this manual contains suggested related curriculums and course descriptions for some of the major apprenticeship programs offered in North Carolina.

° Additional Curriculum guides for other programs will be prepared with the aid of advisory committees and distributed as the need arises and time permits.

° Many of the State Departments of Education in the United States publish Program Guides and Course Outlines for the many apprenticeable trades.

° Refer to the list of the major publishers of materials for sale on page 36 of Section III.

APPRENTICESHIP EDUCATION

SUGGESTED CURRICULUM GUIDES

OE-NCES			Program Codes
17.1000	Building Trades or Construction		W 990
	1001	Carpentry	W 990A
	3601	Cabinet-Making	W 990B
	1004-1	Bricklayer	W 990C
	1004-2	Cement Mason	W 990D
	1005	Painting and Decorating	W 990E
	1007	Plumbing and Pipefitting	W 990F
17.1400	Electrical Occupations		W 990
	1401	Electrician---Residential Industrial, and Commercial	W 990G
	1402	Electrician Lineman & Cable Splicer	W 990H
17.0100	Air Conditioning		W 990I
17.3000	Refrigeration		W 990J
17.2300	Metalworking Occupations		W 991
	2303-1	Machinist	W 991A
	2302-1	Tool & Die Maker	W 991B
	2304	Metal Fabricator	W 991C
	2305	Sheet Metal	W 991D
	2306	Welding	W 991E
17.1300	Drafting Occupations		W 991
	1300-1	Mechanical Draftsman	W 991F
17.1900	Grafic Arts*		
17.0000	Service Trades (Mechanic & Repairman)		W 993
	0301	Automotive Body Repairman	W 993A
	0302	Automotive Mechanic	W 993B
	1200-1	Diesel Mechanic	W 993C
	1200-2	Diesel Mechanic (Heavy Equipment)	W 993D
	3399	Knitting Machine Mechanic	W 993E
	1099	Maintenance Mechanic	W 993F

*Programs will be developed as needed.

01.0300	Agricultural Mechanics	W 993
	0303 Farm Machinery	W 993G
17.0200	Appliance Repair-Electrical	W 993H
17.0500	Sewing Machine Repairman	W 993I
16.0106	Surveying	W 993J

BASIC COURSES APPLIED TO ALL PROGRAMS

COURSE DESCRIPTIONS

No. Title Hours

ENG 1101 Reading Improvement 22

Designed to improve the student's ability to read rapidly and accurately. Special machines are used for class drill to broaden the span of recognition, to increase eye coordination and word group recognition and to train for comprehension in larger units.
Prerequisite: None

ENG 1102 Communication Skills 33

Designed to promote effective communication through correct language usage in speaking and writing.
Prerequisite: ENG 1101.

ENG 1103 Report Writing 22

Fundamentals of correct language usage applied to report writing. Emphasis is on principles of report construction and application to various report forms.
Prerequisite: ENG 1102.

NOTE: THIS LIST OF COURSE DESCRIPTIONS FOR BASIC COURSES SHOULD BE ISSUED WITH EACH PROGRAM GUIDE WHEN REQUESTED.

MATHEMATICS APPRENTICESHIP

COURSE DESCRIPTIONS

No. Title Hours

MAT 1101 Fundamentals of Mathematics 55

Practical number theory. Analysis of basic operations: addition, subtraction, multiplication, and division. Fractions, decimals, powers and roots, percentages, ratio and proportion. Plane and solid geometric figures used in industry; measurement of surfaces and volumes. Introduction to algebra used in trades. Practice in depth.
Prerequisite: None.

MAT 1102 Algebra 55

Basic concepts and operations of algebra: historical background of our base-10 number system; algebraic operations: addition, subtraction, multiplication and division; fractions, letter representation, grouping, factoring, ratio and proportions, variation; graphical and algebraic solution of first degree equations; solution of simultaneous equations by: addition and subtraction, substitution, graphing; exponents, logarithms, tables and interpolation.
Prerequisite: None.

MAT 1103 Geometry 33

Fundamental properties and definitions; plane and solid geometric figures, selected general theorems, geometric construction of lines, angles and plane figures. Dihedral angles, areas of plane figures, volumes of solids. Geometric principles are applied to shop operations.
Prerequisite: None.

MAT 1104 Trigonometry 33

Trigonometric ratios; solving problems with right triangles, using tables, and interpolating; solution of oblique triangles using law of sines and law of cosines; graphs of the trigonometric functions; inverse functions, trigonometric equations. All topics are applied to practical problems.
Prerequisite: MAT 1102, MAT 1103.

COURSE DESCRIPTIONS

No.	Title	Hours
PHY 1101	Applied Science	55

An introduction to physical principles and their application in industry. Topics in this course include measurement; properties of solids, liquids, and gases; basic electrical principles.
Prerequisite: None.

No.	Title	Hours
PHY 1102	Applied Science	55

The second in a series of two courses of applied physical principles. Topics introduced in this course are heat and thermometry, and principles of force, motion, work, energy, and power.
Prerequisite: PHY 1101.

No.	Title	Hours
PHY 1122	Rigging	33

A study of the methods of safe transfer of loads, breaking strength of ropes, cables and chains, knot typing and splicing will be covered whether in construction or industrial work. Slings, scaffolds, ladders, cranes, jacks, and other methods of hoisting and supporting weights will be given detailed treatment with emphasis on their safe and efficient management.

NOTE: The Applied Science courses for apprentices may follow the previous outlines used in trade courses and offer the instruction for four short courses rather than two.

INDUSTRIAL SCIENCE APPRENTICESHIP

COURSE DESCRIPTIONS

No. Title Hours

PSY 1101 Human Relations 33

A study of basic principles of human behavior. The problems of the individual are studied in relation to society, group membership, and relationships within the work situation.
Prerequisite: None.

BUS 1103 Small Business Operations 33

An introduction to the business world, problems of small business operation, basic business law, business forms and records, financial problems, ordering and inventorying, layout of equipment and offices, methods of improving business, and employer-employee relations.
Prerequisite: None.

BUS 1105 Industrial Organizations 33

Methods, techniques, and practices of modern management in planning, organizing and controlling operations of a manufacturing concern. Introduction to the competitive system and the factors constituting product cost.
Prerequisite: None.

ISC 1001 Industrial Safety 33

A study of the overall picture of the accident toll for the nation's population. It is designed to establish safe work habits in performing the occupation. Principles of accident prevention; injury sources and causes; accident costs; job safety analysis; accident investigation; methods of promoting safe practice, safety education and training; first aid; lifting-manually and mechanically; and fire prevention and protection are some of the topics discussed.
Prerequisite: None.

CARPENTRY
OE-NCES 17.1001

INTRODUCTION

Purpose of Program

Carpentry is one of the basic trades in the construction field. Carpenters construct, erect, install, and repair structures of wood, plywood, and wallboard, using hand and powertools. The work must conform to local building codes for both residential and commercial structures.

This curriculum in carpentry is designed to train the individual to become a craftsman in the trade with a background in both on-the-job skills and related information. He must have a knowledge of mathematics, blueprint reading, methods of construction, safety, and a thorough knowledge of building materials. Basic courses are provided to assist the apprentice to develop understandings and confidence in his relations with other persons.

The modern carpenter will work on new construction, maintenance, and repair of many types of structures, both residential and commercial. He should have an understanding of building materials, concrete form construction, rough framing, roof and stair construction, the application of interior and exterior trim, and the installation of cabinets and fixtures.

Most carpenters are employed by contractors in the building construction fields. When specializing in a particular phase of carpentry, the job is designated according to the specialty as layout carpenter, framing carpenter, concrete form carpenter, scaffolding carpenter, accoustical and insulating carpenter, and finish carpenter.

Career Opportunities

The carpenter constructs, erects, installs and repairs structures and fixtures of wood, plywood, wall board and other materials, using carpenters handtools and powertools to conform to local building codes. He is required to use blueprints, sketches or building plans for information pertaining to type of material, dimensions, layout and design of structure, and method of construction.

CARPENTRY PROGRAM
(Cabinetmaking Option)
OE-NCES 17.1001

REQUIRED BASIC COURSES

No.	Title	Hours
ENG 1101	Reading Improvement	22
ENG 1102	Communication Skills	33
ISC 1001	Industrial Safety	33
PSY 1101	Human Relations	33
BUS 1103	Small Business Operations	33
MAT 1101	Fundamentals of Mathematics	55
MAT 1112	Building Trades Mathematics	33
DFT 1110	Blueprint Reading: Building Trades	33
DFT 1111	Blueprint Reading and Sketching	33

REQUIRED RELATED COURSES (CARPENTRY)

A-CAR 1101	Carpentry	55
A-CAR 1102	Carpentry: Millwork and Cabinetmaking	55
A-CAR 1103	Carpentry: Framing	55
A-CAR 1104	Carpentry: Finishing	55
A-CAR 1113	Carpentry: Estimating	55

REQUIRED RELATED COURSES (CABINETMAKING OPTION)

A-CAB 1101	Cabinetmaking Essentials	55
A-CAR 1102	Millwork and Cabinetmaking	55
A-DFT 1141	Building Trades Drafting I	66
A-DFT 1142	Building Trades Drafting II	66
A-DFT 1149	Principles of Cabinet Design	22
A-DFT 1150	Cabinet Layout and Detailing	66

ELECTIVE COURSES

ENG 1103	Report Writing	33
PHY 1101	Applied Science I	55
PHY 1102	Applied Science II	55
PHY 1122	Rigging	33
WLD 1104	Basic Welding and Cutting	33
DFT 1144	Building Materials and Methods	33
DFT 1147	Advanced Blueprint Reading (CAR & CAB)	33
A-CAR 1105	Stair Layout and Finishing	33
A-CAR 1106	Concrete Form Construction	55
A-CAR 1107	Advanced Construction Practices	55
A-CAR 1114	Building Codes	33

BUILDING TRADES

CABINETMAKING AND CARPENTRY
OE-NCES 17.1001

COURSE DESCRIPTIONS

No. Title Hours

A-CAR 1101 Carpentry 55

A brief history of carpentry and present trends of the construction industry. The course will involve operation care and safe use of carpenters' handtools and powertools in cutting, shaping and joining construction materials used by the carpenter. Major topics of study will include theoretical and practical applications involving: materials and methods of construction, building layout, preparation of site, footings and foundation wall construction including form construction and erection.
Prerequisite: None.

A-CAR 1102 Carpentry: Millwork and Cabinetmaking 55

Cabinetmaking and millwork as performed by the general carpenter for building construction. Use of shop tools and equipment will be emphasized in learning methods of construction of millwork and cabinetry. Practical applications will include measuring, layout and construction of: base and wall cabinets, built in desk, door and window frames, stairs, and interior and exterior cornice and trim. Materials and finishes will also be studied.
Prerequisites: A-CAR 1101, DFT 1110.

A-CAR 1103 Carpentry: Framing 55

Instruction is given in the principles and practices of frame construction beginning with the foundation sills and including: floor joist, subfloor, wall studs, ceiling joist, rafters, bridging, bracing, sheathing and interior wall partition. Roof construction includes the layout and construction methods of common types of roofs using standard rafter construction, truss construction, and post and beam construction. Application and selection of sheathing and roofing are included. Consideration is given to the coordination of carpentry work with installation of the mechanical equipment such as: electrical, air conditioning, heating, and plumbing.
Prerequisites: A-CAR 1101, DFT 1111.

A-CAR 1104 Carpentry: Finishing 55

Exterior and interior trim and finish carpentry will complete the general carpentry program. Included will be materials and methods used in finishing carpentry such as: exterior cornice, door and window trim; interior flooring, door and window facing, moldings, and cornice construction, installation of hardware; and installation of built-in equipment and cabinets.
Prerequisites: A-CAR 1103, DFT 1111.

A-CAR 1113 Carpentry: Estimating 55

This is a practical course in quantity "take off" from prints of jobs performed by the carpenter. Figuring the quantities of materials needed and costs of building various components and structures.
Prerequisites: DFT 1111, MAT 1112.

A-CAB 1101 Cabinetmaking Essentials 55

This course is intended for the student wishing to extend his knowledge of cabinetmaking by studying the use of hand tools and woodworking machines. Every student advances from stage to stage, in accordance with his ability and skill on the job. The beginner studies the fundamental operations and procedures for making joints used in cabinetmaking. As he advances in types and methods of construction, and his work with machines progresses, he applies his knowledge to the building of regular projects in the shop or on a field job. He will be required to know how to adjust, sharpen, and maintain the woodworking tools and machines used on the job.
Prerequisite: None.

A-DFT 1141 Building Trades Drafting I 66

An introduction to architectural drafting. Further development of techniques in lettering, dimensioning, freehand sketching and instrument drawing. Drawings of construction details, using appropriate material symbols and conventions. Working drawings, including plans, elevations, sections, scale details and full-size details will be prepared from preliminary sketches.
Prerequisite: A-DFT 1122.

A-DFT 1142 Building Trades Drafting II 66

Individual and group participation in the preparation of complete working drawings for a complex architectural structure. Study of drafting room organization and relationships of personnel within the architectural office.
prerequisites: A-DFT 1141, DFT 1143, and DFT 1144.

A-DFT 1149 Principles of Cabinet Design 22

A study of the fundamental principles of design as they apply to cabinet construction, including vertical and horizontal space divisions, the zoning of these divisions, and their surface enrichment, as well as their contour and form. Assignments give the student practice in making proper space divisions for orignal work. The main objective of this course is to help the worker appreciate and execute cabinet and architectural designs with greater feeling and understanding.
Prerequisites: DFT 1111 or DFT 1147 or Equivalent Drafting Courses.

A-DFT 1150 Cabinet Layout and Detailing 66

Knowledge and practice are gained in laying out the necessary drawings needed to build cabinets, store fixtures, and stairs. Rod and steel square layouts are studied and put into practice. The student makes out bills of material and estimates the cost. Full-size detail drawings are made according to the standard practices in the area.
Prerequisite: A-DFT 1149.

DFT 1110 Blueprint Reading: Building Trades 33

Principles of interpreting blueprints and specifications common to the building trades. Development of proficiency in making three view and pictorial sketches.
Prerequisite: None.

DFT 1111 Blueprint Reading and Sketching 33

Principles of interpreting blueprints and specifications common to the building trades. Practice in reading details for grades, foundations, floor plans, elevations, walls, doors and windows, and roofs of buildings. Development of proficiency in making three view and pictorial sketches.
Prerequisite: DFT 1110.

MAT 1112 Building Trades Mathematics 33

Practical problems dealing with volumes, weights, ratios; mensuration; and basic estimating practices for building materials.
Prerequisite: MAT 1101.

WLD 1104 Basic Welding and Cutting 33

Welding demonstrations by the instructor and practice by students in the welding shop. Safe and correct methods of assembling and operating the welding equipment. Practice will be given for surface welding; bronze welding, silver soldering, arc and gas-arc welding methods applicable to mechanical repair work.
Prerequisite: None.

DFT 1144 Building Materials and Methods 33

Materials used in the construction of architectural structures will be studied. Their economic values and limitations affected by locality, budget, and codes. Field trips to construction sites and study of manufacturer's specifications for materials. Standard sizes of instructural materials and modular construction techniques.
Prerequisite: None.

DFT 1147 Advanced Blueprint Reading: Carpentry Trades 33

This course is designed to help the building trades worker express himself and interpret plans on the job. It includes sketching objects using straight and curved lines. Isometric, oblique, and orthographic views and methods of dimensioning are covered. The students learn to visualize and interpret elevations, plan views, sections, and details from blueprints. They learn the relationship of blueprints and specifications as applied to the building trades.
Prerequisites: DFT 1110 & DFT 1111 or Equivalent.

A-CAR 1105 Stair Layout and Finishing 33

Training is given in laying out and methods of constructing common stairways. The course presents the related technical work at the time the worker is learning to layout stringers, threads, and risers on the job. A study is made of problems involving the size of well openings, the rise and run of stairways, headroom, and the layout of exterior open stairways and interior straight and winding stairways. Finishing methods of the various types of stairways and their parts are studied.
Prerequisite: A-CAR 1102.

A-CAR 1106 Concrete Form Construction 55

It covers the basic understanding and elementary methods of concrete form construction. It presents the work terms, materials, and methods used in constructing footing, wall, pier, floor, stairway forms, and those for arched openings. The fundamental details in erecting modern fireproof and fire-resisting buildings are studied.
Prerequisite: A-CAR 1101.

A-CAR 1107 Advanced Construction Practices 55

An advanced course dealing with the layout and construction of special types of roofs of equal and unequal pitch. Practice is provided in the use of the steel square for laying out the rafter cuts. Instruction is given in the mathematics necessary to find the lengths of various types of rafters and estimating of special projects. Emphasis is upon shortcuts and simplifications of layouts. Scale models of projects are made when possible.
Prerequisite: A-CAR 1103 or Journeyman Carpenter.

A-CAR 1114 Building Codes 33

A study is made of building codes and the minimum requirements for local, county, and state construction regulations. This involves safety, sanitation, mechanical equipment and materials. Also, a review will be made of the minimum property requirements of the Federal Housing Administration and the North Carolina State Code. Prerequisite: A-CAR 1103.

BRICKLAYING AND MASONRY
(3 yrs.)
OE-NCES 17.1004-1

Purpose of Program

Masons are the craftsmen in the building trades that work with artificial stone, brick, concrete masonry units, stone and the like. During the past decade there has been a steady increase in the demand for these craftsmen. As building construction continues to increase the demand for bricklayers, cement masons, and stonemasons will also increase.

This program in Masonry is designed to train the individual to become a craftsman in the trade with the knowledge and basic skills that will enable him/her to perform effectively. He/she must have a knowledge of basic mathematics, blueprint reading and masonry technology. He/she must know the methods used in laying out a masonry job with specific reference to rigid insulation, refractories, and masonry units specified for residential, commercial and industrial construction. Other related courses are provided to develop proper human relations and safe habits at work and home.

Most employment opportunities for masons may be found with contractors in new building construction. However, a substantial proportion of masons are self-employed or work with contractors doing repair, alteration, or modernization work.

Career Opportunities

Most masons are employed by contractors in the building construction fields to lay brick, and blocks made of tile, concrets, glass, gypsum or terra cotta. Also, he/she constructs or repairs walls, partitions, arches, sewers, furnances and other masonry structures.

After gaining experience in the various types of the masonry trade along with leadership training, it is possible for the tradesman to become a foreman, inspector and eventually a contractor.

BRICKLAYING AND MASONRY
(3 yrs.)
OE-NCES 17.1004-1

REQUIRED BASIC COURSES

No.	Title	Hours
ENG 1101	Reading Improvement	22
ENG 1102	Communication Skills	33
ISC 1001	Industrial Safety	33
PSY 1101	Human Relations	33
MAT 1101	Fundamentals of Mathematics	55

REQUIRED RELATED COURSES

No.	Title	Hours
A-MAS 1113	Masonry Estimating	55
A-MAS 1121	Bricklaying I	55
A-MAS 1122	Bricklaying II	55
A-MAS 1123	Bricklaying III	55
MAT 1112	Building Trades Mathematics	33
DFT 1110	Blueprint Reading: Building Trades	33
DFT 1111	Blueprint Reading and Sketching	33

ELECTIVE COURSES

No.	Title	Hours
DFT 1112	Blueprint Reading and Sketching	33
A-MAS 1104	Advanced Bricklaying	55
A-MAS 1105	Concrete Technology	55
A-MAS 1106	Masonry Materials	33
A-MAS 1107	Fireplace Construction	33
A-MAS 1108	Arches, Panels and Stonework	55
A-MAS 1109	Applied Methods of Bricklaying & Masonry	44
A-MAS 1110	Quantity Survey for Masons	33

BRICKLAYING AND MASONRY
(3 yrs.)
OE-NCES 17.1004-1

COURSE DESCRIPTIONS

No. Title Hours

A-MAS 1113 Masonry Estimating 55

This is a practical course in quantity "takeoff" from prints of the more common type jobs for bricklayers and masons. Figuring the quantities of materials needed and costs of building various components and structures.
Prerequisite: MAS 1103.

A-MAS 1121 Bricklaying I 55

Instruction is provided in the history of the bricklaying industry, raw materials, basic manufacturing processes, and terminology. The use, care, and maintenance of tools and equipment of the "trowel trades" are studied. On-the-job safety practices for the specific trades are stressed. Such topics as mixing and stringing mortar, laying brick, cutting masonry materials, bonding, joints, corner and wall construction are covered.
Prerequisite: None.

A-MAS 1122 Bricklaying II 55

This course covers the intermediate phases as applied to the practices and methods in the masonry trades. Designed to give the student practice in selecting the proper mortars, layout, and construction of various building elements such as foundations, walls, chimneys, arches, cavity walls, concrete floors and pavements. The proper use of bonds, expansion strips, wall ties and caulking methods are stressed.
Prerequisite: A-MAS 1121.

A-MAS 1123 Bricklaying III 55

Related instruction is given in the more advanced phases of the trade, such as reinforced grouted brick masonry, chimneys and fireplaces, arches, floors and pavements, glazed tile panels, decorative stone including granite, marble and sandstone, adhesive terra cotta and modular masonry construction.
Prerequisite: A-MAS 1102.

A-MAS 1106 Masonry Materials 33

The sources of raw masonry materials, the processes of manufacture, the characteristics of these materials, and their specific uses in building construction are studied in this course. The purpose is to enrich the background of the student interested in the practical application of materials used in the bricklaying and masonry field.
Prerequisite: None.

A-MAS 1107 Fireplace Construction 33

A practical course in fireplace construction with emphasis upon the application of scientific principles essential for a workable fireplace. Instruction is given in laying out and constructing both a natural and a modified fireplace. Emphasis is placed on the details of the natural fireplace, such as the hearth, firebox, smoke chamber, and face.
Prerequisite: A-MAS 1104.

A-MAS 1108 Arches, Panels, and Stonework 55

A practical course covering such common arches as the segmental, gothic, semicircular, elliptical, and jack arches; brick panels with diagonal, basket weave, herringbone, and saw tooth patterns; stonework for arches and various bonds, such as the random ashlar and coursed ashlar. Methods are given and sketches are made in laying out for arches, panels, and stonework; and the cutting and laying of brick and stone.
Prerequisite: A-MAS 1104.

A-MAS 1109 Applied Methods of Bricklaying and Masonry 44

A course in applied methods for bricklaying and masonry apprentices and journeymen. Principles and specific problems are studied and sketches are made and specifications written. Such topics as terminology and theory of fireplace construction, brick arch and brick panel construction, plain and geometric ashlar stone construction, acute and obtuse corner construction, glass block, and facing tile construction are covered.
Prerequisite: Industrial apprentice or journeyman bricklayer.

A-MAS 1110 Quantity Survey for Masons 33

This is a practical course in quantity survey for bricklayers and masons. It includes the listing of all materials used in a structure in terms of various sizes, amounts, and styles. The course follows quantity survey methods common in the local building trades.
Prerequisite: MAT 1112.

MAT 1112 Building Trades Mathematics 33

Practical problems dealing with volumes, weights, ratios, mensuration, and basic estimating practices for building materials.
Prerequisite: MAT 1101.

DFT 1110 Blueprint Reading: Building Trades 33

Principles of interpreting blueprints and specifications common to the building trades. Development of proficiency in making three view and pictorial sketches.
Prerequisite: None.

DFT 1111 Blueprint Reading and Sketching 33

Principles of interpreting blueprints and specifications common to the building trades. Practice in reading details for grades, foundations, floor plans, elevations, walls, doors and windows, and roofs of buildings. Development of proficiency in making three view and pictorial sketches.
Prerequisite: DFT 1110.

DFT 1112 Blueprint Reading and Sketching 33

Designed to develop abilities in reading complex drawings in the masonry field. Blueprints of residential and commercial buildings will be studied with emphasis on the plot plan, floor plan, basement and/or foundation plan, walls and various detailed drawings of masonry work.
Prerequisite: DFT 1111.

A-MAS 1104 Advanced Bricklaying 55

Instruction is given in constructing walls with various brick bonds, brick sills, quoin corners, blocked walls, details of veneering, and glass blocks. Emphasis is placed upon developing on-the-job skills in cutting brick, laying out, buttering brick, plumbing, and leveling that will conform with accepted standards in the bricklaying trade.
Prerequisite: A-MAS 1123.

A-MAS 1105 Concrete Technology 55

This is a survey course offered for the construction industry, where there is an acute shortage of qualified concrete technicians, inspectors, workers, and finishers. New developments backed by years of research have provided todays concrete user with unique, attractive and practical products. Concrete products are studied from the history, design, job mixing, finishing, reinforcement, hot and cold weather curing, and the many uses for today and tomorrow.
Prerequisite: None.

CEMENT MASONRY

(3 Years)

OE-NCES 17.1004-2

INTRODUCTION

Purpose of Program

The growth of the concrete construction industry, partially a result of the population boom, and the increasing use of concrete products have combined to create an acute shortage of qualified concrete technicians, inspectors, workers and finishers. The total production of portland cement in the United States has doubled in the last fifteen years. The concrete industries' outlook is one of steady growth through the decades ahead.

The development of new or improved concrete products and methods, technical service, promotion and educational effort, including safety work, are primarily designed to improve and extend the uses of portland cement and concrete. This activity brought new demands that the instruction for the beginning craftsman unfold the fundamental principles of concrete work in simple terms. As the apprentice progresses, both the on-the-job training and the related instruction becomes more technical.

The outlines of the various courses are designed to help the instructors to present the courses in the fundamentals of concrete technology more effectively. Other basic related courses such as, reading improvement, communication skills, safety, applied mathematics, print reading and human relations will help the apprentice not only to become a better craftsman, but also, to develop into a good citizen of his community.

Career Opportunities

For the trained person, the concrete industries offer unlimited job opportunities which range from manufacture, transportation, producing and placing of concrete products, promotion of concrete construction, and research in cement and concrete technology.

Perhaps the most important personal qualification for a concrete worker is integrity. A person connected with the concrete industry must be a conscientious, hard worker to succeed as a mason.

The beginning worker generally starts as a cement mason or a worker in the manufacturing of cement. There is excellent opportunities for steady employment, advancement to supervisory positions, and establishment of new businesses.

CEMENT MASONRY
(3 Years)
OE-NCES 17.1004-2

REQUIRED BASIC COURSES

No.	Title	Hours
ENG 1101	Reading Improvement	22
ENG 1102	Communication Skills	33
ISC 1001	Industrial Safety	33
PSY 1101	Human Relations	33
MAT 1101	Fundamentals of Mathematics	55
MAT 1112	Building Trades Math	33
MAS 1113	Masonry Estimating	55
DFT 1110	Blueprint Reading: Building Trades	33
DFT 1111	Blueprint Reading and Sketching	33

REQUIRED RELATED COURSES

A-MAS 1131	Cement Masonry I	55
A-MAS 1132	Cement Masonry II	55
A-MAS 1133	Cement Masonry III	55

ELECTIVE COURSES

A-MAS 1105	Concrete Technology	55
A-MAS 1106	Masonry Materials	33
A-MAS 1110	Quantity Survey for Masons	33
A-MAS 1130	Concrete Estimating	33
DFT 1112	Blueprint Reading and Sketching	33

CEMENT MASONRY
(3 Years)
OE-NCES 17.1004-2

COURSE DESCRIPTIONS

No.	Title	Hours

MAT 1112 Building Trades Math 33

Practical problems dealing with volumes, weights, ratios; mensuration; and basic estimating practices for building materials.
Prerequisite: MAT 1101.

MAS 1113 Masonry Estimating 55

This is a practical course in quantity "take off" from prints of the more common type jobs for bricklayers and masons. Figuring the quantities of materials needed and costs of building various components and structures.
Prerequisite: MAS 1103.

DFT 1110 Blueprint Reading: Building Trades 33

Principles of interpreting blueprints and specifications common to the building trades. Development of proficiency in making three view and pictorial sketches.
Prerequisite: None.

DFT 1111 Blueprint Reading and Sketching 33

Principles of interpreting blueprints and specifications common to the building trades. Practice in reading details for grades, foundations, floor plans, elevations, walls, doors and windows, and roofs of buildings. Development of proficiency in making three view and pictorial sketches.
Prerequisite: DFT 1110.

A-MAS 1131 Cement Masonry I 55

This is a course in the history of apprenticeship, history of cementing materials, Portland cement, and aggregates. Includes a study of the use of hand tools, power equipment, safety practices, and applied blueprint reading for the trade.
Prerequisite: None.

A-MAS 1132 Cement Masonry II 55

Related instruction is offered in the uses and properties of concrete. The course includes placing finishing concrete surfaces, slabs, paving, curb and mass concrete, architectural concrete finishes, colored concrete, bonding concrete, expansion and contraction of concrete, and curling concrete.
Prerequisite: A-MAS 1131.

A-MAS 1133 Cement Masonry III 55

Instruction covers application of mathematics to job problems, job layout, admixtures, pozzolanic materials, industrial relations, building codes, and blueprint reading.
Prerequisite: A-MAS 1132.

A-MAS 1105 Concrete Technology 55

This is a survey course offered for the construction industry, where there is an acute shortage of qualified concrete technicians, inspectors, workers, and finishers. New developments backed by years of research have provided todays concrete user with unique, attractive and practical products. Concrete products are studied from the history, design, job mixing, finishing, reinforcement, hot and cold weather curing, and the many uses for today and tomorrow.
Prerequisite: None.

A-MAS 1106 Masonry Materials 33

The sources of raw masonry materials, the processes of manufacture, the characteristics of these materials, and their specific uses in building construction are studied in this course. The purpose is to enrich the background of the student interested in the practical application of materials used in the bricklaying and masonry field.
Prerequisite: None.

A-MAS 1110 Quantity Survey for Masons 33

This is a practical course in quantity survey for bricklayers and masons. It includes the listing of all materials used in a structure in terms of various sizes, amounts, and styles. The course follows quantity survey methods common in the local building trades.
Prerequisite: MAT 1112.

A-MAS 1130 Concrete Estimating 33

A specialized course in how to estimate concrete for various jobs. Prints and specifications from actual building projects should be used to calculate quantities or materials required for job batching. Estimating short cuts and small concrete calculators are used for quick checking of calculations.
Prerequisite: MAT 1101.

DFT 1112 Blueprint Reading and Sketching 33

Designed to develop abilities in reading complex drawings in the masonry field. Blueprints of residential and commercial buildings will be studied with emphasis on the plot plan, floor plan, basement and/or foundation plan, walls and various detailed drawings of masonry work.
Prerequisite: DFT 1111.

PAINTING AND DECORATING
OE-NCES 17.1005

INTRODUCTION

Purpose of Program

The Bureau of Labor Statistics estimates that approximately 305,000 painter craftsmen will be in the construction industry by 1980, an increase of 20,000 above the 285,000 employment level during 1965. Approximately 95,000 job openings will be available for journeymen painters in the construction industry during 1965-75 period. Of these, 75,000 will replace journeymen losses resulting from death and retirement, and 20,000 from increased demand.

In order to prepare qualified people to enter the painting and decorating trade as skilled craftsmen, the following related instruction program has been prepared.

The main objective of this guide is to provide related technical information needed to better preform the on-the-job skills and assigned operations. Other purposes are to teach proper safety procedures and to establish acceptable work habits; to develop the correct habits and techniques in the use of tools in the application of materials; to develop initiative, judgment, and an attitude for accepting individual responsibility in working with people.

Career Opportunities

The painting and decorating craftsman is concerned with the preparation and finishing of exterior and interior surfaces. He applies to these surfaces protective or decorative coating materials such as lacquer, paint and wall-papers. His job includes scraping, burning, or sanding surfaces; making, mixing, and matching paints and colors. He applies coats of these materials with brushes, rollers, or spray-gun, or by cutting, pasting, and hanging wallpaper.

PAINTING AND DECORATING
OE-NCES 17.1005

REQUIRED BASIC COURSES

No.	Title	Hours
ENG 1101	Reading Improvement	22
ENG 1102	Communication Skills	33
MAT 1101	Fundamentals of Mathematics	55
PSY 1101	Human Relations	33
ISC 1001	Industrial Safety	33
BUS 1103	Small Business Operations	33

REQUIRED RELATED COURSES

DFT 1110	Blueprint Reading: Building Trades	33
DFT 1111	Blueprint Reading & Sketching	33
PAD 1101	Painting and Decorating I	44
PAD 1102	Painting and Decorating II	44
PAD 1103	Painting and Decorating III	44
PAD 1104	Painting and Decorating IV	44
PAD 1105	Industrial Painting	33
PAD 1106	Color in Paints & Decorating Materials	22
PAD 1107	Paperhanging--Specialty Materials	22
PAD 1108	Speciality Finishes and Coatings	22
PAD 1109	Wood Finishing	33
PAD 1116	Estimating--Materials and Costs	33

ELECTIVE COURSES

PHY 1122	Rigging	33
ENG 1103	Report Writing	33
A-CAR 1114	Building Codes	33
PAD 1110	Interior Decorating	33

BUILDING TRADES

PAINTING AND DECORATING
OE-NCES 17.1005

COURSE DESCRIPTIONS

No.	Title	Hours
DFT 1110	Blueprint Reading: Building Trades	33

Principles of interpreting blueprints and trade specifications common to the building trades. Development of proficiency in making three view and pictorial sketches.
Prerequisite: None.

No.	Title	Hours
DFT 1111	Blueprint Reading and Sketching	33

Principles of interpreting blueprints and specifications common to the building trades. Practice in reading details for grades, foundations, floor plans, elevations, walls, doors and windows, and roofs of buildings. Development of proficiency in making three-view and pictorial sketches.
Prerequisite: DFT 1110.

No.	Title	Hours
PAD 1101	Painting and Decorating I	44

The apprentice should know the historical background and development of the trade; how to study and retain knowledge; health and safety rules; federal, state, and local laws governing the worker.

Information is given on the selection, preparation and application of materials such as, proper paints and wall coverings; and the basic use and care of tools of the trade. Special attention is given to the preparation of plaster, masonry and concrete surfaces.
Prerequisite: None.

No.	Title	Hours
PAD 1102	Painting and Decorating II	44

Instruction provides advanced study of the basic topics; trade chemistry; the art of preparing colors; methods used in applying materials; brushing; spray painting techniques; materials problems and equipment maintenance; hardwood and hardwood finishes.
Prerequisite: PAD 1101 or equivalent.

PAD 1103 Painting and Decorating III 44

Additional instruction is given for advanced students in the use of tools and materials. They are taught basic blueprint reading, drawing, and sketching along with basic design methods, architectural decorating practices and finishes along with interpretation of specifications.
Prerequisite: PAD 1102 or equivalent.

PAD 1104 Painting and Decorating IV 44

Additional instruction is given on preparation of surfaces, selection and use of hand tools, materials, and equipment for the safe and economical application of wall papers, canvas, muslin, and other fabrics. Take off quantities from prints and specifications for estimates of materials and size of areas are used to compute the labor costs. Included in the course are systems of color notation; principles of harmony; psychology of color; color design; color chemistry; and the mixing and matching of color with materials of the trade.
Prerequisite: PAD 1103 or equivalent.

PAD 1105 Industrial Painting 33

Problems encountered in industrial painting not common to residential painting are discussed and calculations made for materials, scoffolding and equipment. The maximum utilization of equipment, scoffolding, labor and materials is emphasized.
Prerequisite: PAD 1104.

PAD 1106 Color in Decorating Materials 22

Studies are made of the basic theory of color and color harmony. The student makes a color wheel to help him become familiar with the elaborate schemes for classifying colors. Systems used to identify and analyze, and measure color will be included.
Prerequisite: PAD 1101.

PAD 1107 Paperhanging--Specialty Materials 22

This course is a study of preparation of surfaces, measuring, tools and equipment used for paperhanging; adhesives and their applications, and hanging standard papers. Special instruction regarding papering around windows and doors, and the use of fine papers, fabrics, and vinyls.
Prerequisite: None.

PAD 1108 Speciality Finishes and Coatings 22

Instruction includes experiences in marbleizing, graining, texturing, glazing, antiquing, stenciling, striping and lining.
Prerequisites: PAD 1101 and PAD 1102.

PAD 1109 Wood Finishing 33

This course includes study of the types of wood and their preservation, preparation and sanding, removing finish and refinishing, bleaching, and staining. The use of filler, sealer, varnish, shellac, lacquer, wax, and oil for woods are included. Techniques of rubbing, polishing, buffing and repairing wood finishes will be emphasized.
Prerequisites: PAD 1101 and PAD 1102.

PAD 1110 Interior Decorating 33

Principles of interior decorating are emphasized, with regard to paints and wall coverings, to achieve both an artistic and functional effect. Paint and wall paper should produce the effect desired by the employer with relation to furniture, draperies, and floor coverings.
Prerequisites: PAD 1101, PAD 1102, PAD 1103, and PAD 1104.

PAD 1116 Estimating--Materials and Costs 33

Problems in estimating labor and materials from situations given in the related mathematics text. Estimating of labor, materials and overhead costs from figures and measurements of jobs small and large shown on building prints.
Prerequisite: MAT 1101.

A-CAR 1114 Building Codes 33

A study is made of building codes and the minimum requirements for local, county, and state construction regulations. This involves safety, sanitation, mechanical equipment and materials. Also, a review will be made of the minimum property requirements of the Federal Housing Administration and the North Carolina State Code.
Prerequisite: CAR 1104.

PLUMBING AND PIPEFITTING
OE-NCES 17.1007

INTRODUCTION

Purpose of Program

Plumbers are the craftsmen who install pipe systems which carry water, steam, air, or other liquids or gases needed for sanitation, heating, industrial production and various other uses. During the past decade there has been a steady increase in the demand for these draftsmen. As building construction continues to increase this demand for plumbers will also increase.

This program in plumbing and pipefitting is designed to train the individual to enter this occupation with the knowledge and basic skills that will enable him to perform effectively. On-the-job practices provide practical experience as well as certain theoretical information that one must know to advance and keep up-to-date with new innovations. Other courses in applied science, communication skills, safety, human relations and business operations are provided to assist the individual in occupational growth.

Opportunities for plumbers and pipefitters may be found with plumbing and pipefitting contractors in new building construction. A substantial proportion of plumbers are self-employed or work for plumbing contractors doing repair, alteration, or modernization work. Some plumbers install and maintain pipe systems for government agencies and public utilities, and some work on the construction of ships and aircraft. Pipefitters, in particular, are employed as maintenance personnel in the petroleum, chemical, and food-processing industries.

Career Opportunities

Most plumbers are employed by contractors in the building construction fields to install pipe systems which carry water, steam, air or other liquids or gases for sanitation, heating, industrial production and various other uses. They also alter and repair existing pipe systems and install plumbing fixtures, appliances, and heating and refrigeration units.

Plumbing and pipefitting are sometimes considered to be a single trade, journeymen in this field can specialize in either one. Water, gas, and waste disposal systems are installed by plumbers. Pipefitters install both high and low pressure pipes that carry hot water, steam, and other liquids and gases, especially those in industrial and commercial buildings and defense establishments, such as missile launching and testing sites.

PLUMBING AND PIPEFITTING
OE-NCES 17.1000

REQUIRED BASIC COURSES

No.	Title	Hours
ENG 1101	Reading Improvement	22
ENG 1102	Communication Skills	33
ISC 1001	Industrial Safety	33
PSY 1101	Human Relations	33
BUS 1103	Small Business Operations	33
MAT 1101	Fundamentals of Mathematics	55
MAT 1102	Applied Algebra	55
MAT 1105	Plumbers and Pipefitters Mathematics	33
DFT 1110	Blueprint Reading: Building Trades	33
DFT 1115	Blueprint Reading: Plumbing Trades	33
PHY 1101	Applied Science	55
PHY 1102	Applied Science	55

REQUIRED RELATED COURSES

A-PLU 1101	Plumbing and Pipefitting - Fundamentals	33
A-PLU 1102	Plumbing and Pipefitting - Screw pipe & flanges	33
A-PLU 1103	Plumbing and Pipefitting - Fixtures	33
A-PLU 1104	Plumbing and Pipefitting - Soil, Waste, and Vent Pipes	33
A-PLU 1105	Plumbing and Pipefitting - Offsets, Hangers	33
A-PLU 1106	Plastic Pipe Welding & Fabrication	22
WLD 1104	Basic Welding and Cutting	33

ELECTIVE COURSES

A-PLU 1120	Low Pressure Steam Systems	33
A-PLU 1121	High Pressure Steam Systems	33
A-PLU 1123	Hot Water and Panel Heating	33
A-PLU 1125	Industrial Piping	33
A-PLU 1126	Hydraulic Systems Piping	22
A-PLU 1130	Plumbing Code I	22
A-PLU 1131	Plumbing Code II	22
PHY 1122	Rigging	33
A-WLD 1109	Welding: Brazing Process & Copper Pipe Work	33

PLUMBING AND PIPEFITTING
OE-NCES 17.1000

COURSE DESCRIPTIONS

No. **Title** **Hours**

DFT 1110 Blueprint Reading: Building Trades 33

Principles of interpreting blueprints and specifications common to the building trades. Development of proficiency in making three view and pictorial sketches.
Prerequisite: None.

DFT 1115 Blueprint Reading: Plumbing Trades 33

Sketching diagrams and schematics, and interpretation of blueprints applicable to the plumbing trades. Emphasis will be on plumbing plans for domestic and commercial buildings. Piping symbols, schematics, diagrams and notes will be studied in detail. Applicable building and plumbing codes will be used for reference.
Prerequisite: DFT 1110.

MAT 1105 Plumbers and Pipefitters Mathematics 33

Emphasis is placed upon the development of usable skills in the layout, measurements and computations of pipe lengths, including fitting allowances. Volumes, pressure, capacities, cylinder stretchouts, heat loss, radiator size and estimating the size of piping are subjects for various calculations.
Prerequisite: MAT 1101.

A-PLU 1101 Plumbing and Pipefitting - Fundamentals 33

A study of the specifications, applications, installations and maintenance of various kinds of pipes, fittings, valves, pumps, hand tools, and small equipment used in the pipefitting trade. Methods of threading, cutting, caulking, and sweating of the various kinds of pipe and tubing used in the trade are presented.
Prerequisite: None.

A-PLU 1102 Plumbing and Pipefitting - Screw Pipe & Flanges 33

A study of materials and installation of water distribution systems beginning with the source of supply and including the location of pipes, valves, joints in both single-story and multi-story buildings. Information is presented as set up in the North Carolina Plumbing Code relative

A-PLU 1102 continued

to installation of rural and city water supply systems. Piping quantity of water required, cross connections, and the well-construction code are discussed. A study is made of the types of hot water supply and their installation.
Prerequisites: A-PLU 1101.

A-PLU 1103 Plumbing and Pipefitting - Fixtures 33

A study of code requirements, design features, and installation procedures of plumbing fixtures such as water closets, lavatories, shower baths, sinks, urinals, and drinking fountains. The proper use of traps is included. Quality workmanship and safety are stressed throughout the course.
Prerequisites: A-PLU 1102.

A-PLU 1104 Plumbing and Pipefitting - Soil, Waste, and Vent Pipes 33

A study of materials used for sewer pipe, soil pipe, vent pipe, and fittings; sewage disposal, storm drainage, and ventilation; soil waste, and vent pipe principles. It includes a study of design, installation and maintenance of grease catch basins; the quality weight, and design and use of traps; and cast iron, wrought iron, steel, copper, brass, and lead pipe and fittings.
Prerequisite: A-PLU 1101.

A-PLU 1105 Plumbing and Pipefitting--Offsets & Hangers 33

This course deals with soil pipe offsets by means of sixteenth and sixth bends, principles of pipe bending and bending equipment; pipe hangers, clamps, supports, and fastenings; screwed drainage fittings and their application; and the installation and use of the plumbing trap.
Prerequisite: A-PLU 1104.

A-PLU 1106 Plastic Pipe Welding & Fabrication 22

This course introduces the apprentice to plastic pipe and the equipment needed to weld it. The operation of the torch and safety precautions; the starting of plastic welds, the rod manipulation, stopping the weld and welding the pipe are discussed and demonstrated. The student should be allowed to practice and make welded plastic joints on the job.
Prerequisite: WLD 1104.

WLD 1104 Basic Welding and Cutting 33

Welding demonstrations by the instructor and practice by students in the welding shop. Safe and correct methods of assembling and operating the welding equipment. Practice will be given for surface welding; bronze welding, silver soldering, arc and gas-arc welding methods applicable to mechanical repair work.
Prerequisite: None.

A-PLU 1120 Low Pressure Steam Systems 33

The student will become acquainted with types of low pressure steam boilers, and the principles of boiler operation. Boiler accessories such as connectors, fittings, and insulation are to be included. Low pressure steam systems, their layout, and component parts will be studied and installed. Equipment used in heat transmission, such as radiators, coils, and connectors will be included.
Prerequisites: A-PLU 1101 or PLU 1111.

A-PLU 1121 High Pressure Steam Systems 33

Applications of low pressure steam equipment will be continued. Principles involved in industrial applications of both low-pressure and high-pressure steam equipment. Commercial and industrial blueprints will be studied utilizing low and high pressure equipment. High pressure boilers and installations of high pressure systems will be emphasized.
Prerequisite: A-PLU 1120.

A-PLU 1123 Hot Water and Panel Heating 33

The piping and accessory equipment needed to transfer hot water to radiators, heaters, and coils, and the advantages and disadvantages of each of these units will be studied, including apparatus for radiant heating and panel heating. Methods of "sizing" equipment for various installations will be included. Practical application will be provided in installing this equipment.
Prerequisites: A-PLU 1120, or A-PLU 1102.

A-PLU 1125 Industrial Piping 33

Piping systems of boilers, turbines, and steam engines especially as they are used in steam power plants, and process piping such as is used in the chemical industries will be the major emphasis of this course.
Prerequisites: A-PLU 1103

A-PLU 1126 Hydraulic Systems Piping 22

Plumbing applications in hydraulic systems. Hydraulic principles, circuits, control valves, actuators, pumps, fluids and various accessories that complete hydraulic systems will be studied. Installation and servicing methods of these systems will be undertaken.
Prerequisites: A-PLU 1101, or A-PLU 1102.

A-PLU 1130 Plumbing Code I 22

A study of plumbing definitions and the rules and regulations governing quality, installation, and maintenance of materials. Consideration is given to the rules and regulations pertaining to joints and connections, traps and cleanouts, water supply and distribution, plumbing fixtures, drains and sewers, and pumps.
Prerequisites: A-PLU 1101, 1102, 1103, & 1104 or equivalent.

A-PLU 1131 Plumbing Code II 22

A study of the rules and regulations governing quality, installation and maintenance of storage heaters, storage tanks, and appliances. Regulations governing public water supply treatment, workmanship licenses, permits and fees. Inspection and tests and standard specifications for pipe maintenance procedures. Quantity take-off of pipe and equipment from a blueprint and calculating cost of fixtures and labor for installation is a typical problem in interpreting the plumbing code.
Prerequisites: A-PLU 1120 thru A-PLU 1126 or equivalent.

A-WLD 1109 Welding: Brazing Process & Copper Pipe Work 33

This course is open to plumbers only. Instruction is offered to supplement a plumber's skill in electric arc and oxyacetylene processes including silver soldering. The course covers technical terms, torches, fluxes, metal alloys, brazing rules, practice in making brazed joints (especially copper pipe) and testing of complete work.
Prerequisite: WLD 1104; A journeyman or an advanced apprentice.

N.C. DEPARTMENT OF COMMUNITY COLLEGES
Apprenticeship Training

Related and Technical Instruction Outline for the ELECTRICAL TRADE (Domestic, Commercial & Industrial)

INTRODUCTION:

This outline includes that portion of the Apprenticeship Program which is conducted in the related areas of the training. The "on-the-job" skill development phase, which constitutes the major part of the program, is conducted by the employer in work situations. In addition, there are electrical experiments to be conducted and various components to be analyzed in the school laboratory. In some instances, certain types of trade skills are not readily learned on-the-job and should be taught in a school laboratory situation. Where this occurs, the required laboratory work may be offered in addition to the related instruction. In any program the related area of the training should be coordinated with the "shop" or "on-the-job" phase of the program. Minor variations in this schedule may be made to meet local conditions.

OBJECTIVES:

The main objectives of the instruction for electrical apprentices covered in this outline are to develop:

(a) an understanding of the basic technical knowledge needed in the trade
(b) the ability to perform the basic mathematical calculations required
(c) the ability to read (electrical) blueprints and make sketches
(d) desirable attitudes towards health, safety, and human relations
(e) skills not readily learned on-the-job

TIME ALLOTMENT IN HOURS:

The following figures show the approximate minimum time allotment in hours for the various subjects covered in this outline for each year.

Related Subjects	1st Year	2nd Year	3rd Year	4th Year	Total
Basic Mathematics	20	20	20	20	80
Fundamentals of Electricity and Lab.	74	80	80	75	309
National Electrical Code	20	20	15	25	80
Blueprint Reading & Sketching	20	20	25	20	85
Orientation, Safety, etc.	10	4	4	4	22
Total	144	144	144	144	576

Recommended: Additional Lab. Experience Comm. Skills Human Relations

W 9906 January, 1977

ELECTRICAL LINEMAN
OE-NCES 17.1402

REQUIRED BASIC COURSES

No.	Title	Hours
ENG 1101	Reading Improvement	22
ENG 1102	Communication Skills	33
MAT 1101	Fundamentals of Mathematics	55
PHY 1101	Applied Science I	55
PHY 1102	Applied Science II	55
PSY 1101	Human Relations	33

REQUIRED RELATED COURSES

A-ELC 1131	Electrical Lineman: Theory & Application I	44
A-ELC 1132	Electrical Lineman: Theory & Application II	44
A-ELC 1133	Electrical Lineman: Theory & Application III	44
A-ELC 1134	Electrical Apparatus	44
ELC 1141	First Aid	22
ELC 1142	First Aid--Advanced	22
ELC 1143	Electrical Safety Codes	22
ELC 1144	Electrical Safety Codes	22
DFT 1120	Blueprint Reading: Maps & Sketches	22
MAT 1122	Electrical Mathematics	33

ELECTIVE COURSES

ISC 1001	Industrial Safety	33
PHY 1122	Rigging	33

Approximate Hours

Introduction To Electricity	4	Transformers	20
Ohms Law and Applications	20	Motors & Generators	20
Wire Construction & Sizes	6	Motor Controls	24
Types of Circuits & Testing	8	Alternating Currents	30
Magnets and Magnetism	6	Control Circuits	20
Power and Work	4	Electronic Controls	26
Lighting & Lamps	16	Instruments	10
Inductance & Capacity	20	Laboratory Demonstrations & Practical Applications	75
		TOTAL	309
		MINIMUM TOTAL HOURS FOR COURSE	576

ELECTRICAL INSTALLATION
RESIDENTIAL, COMMERCIAL & INDUSTRIAL
OE-NCES 17.1401

INTRODUCTION

Purpose of Program

The rapid expansion of the national economy and the increasing development of new electrical products is providing a growing need for qualified people to install and maintain electrical equipment. Between 5,000 and 10,000 additional tradesmen are required each year to replace those leaving the industry. It is expected that the total requirements for electrical tradesmen will reach 700,000 by 1970. The majority of the electrical tradesmen today are trained through apprenticeship or on-the-job training programs.

This program guide will provide a training program in the basic knowledge, fundamentals, and practices involved in the electrical trades. A large portion of the total program is devoted to laboratory and on-the-job instruction which is designed to give the student practical knowledge and application experience in the fundamentals taught in class.

Career Opportunities

The graduate apprentice of the electrical installation program will be qualified as a journeyman electrician in the construction trades. He/she will assist in the planning, layout, installation, check out, and maintenance of systems in residential, commercial, or industrial plants. He will have an understanding of the fundamentals of the National Electrical Code regulations as related to wiring installations, electrical circuits, and the measurements of voltage, current, power, and power factor of single and polyphase alternation circuits.

He will have a basic knowledge of motor and motor control systems; industrial electronic control systems; business procedures, organization, and safety practices; communicative skills; and the necessary background to be able to advance to positions of leadership through experience and additional training.

ELECTRICAL INSTALLATION
RESIDENTIAL, COMMERCIAL & INDUSTRIAL
OE-NCES 17.1401

REQUIRED BASIC COURSES

No.	Title	Hours
ENG 1101	Reading Improvment	22
ENG 1102	Communication Skills	33
ISC 1101	Industrial Safety	33
PSY 1101	Human Relations	33
MAT 1101*	Fundamentals of Mathematics	55

REQUIRED RELATED COURSES

A-ELC 1151	Basic Electricity I	55
A-ELC 1152	Basic Electricity II	55
A-ELC 1153	Basic Electricity III	55
A-ELC 1154	Basic Electricity IV	55
A-ELC 1124	Residential Wiring	55
A-ELC 1125	Commercial & Industrial Wiring	55
A-ELN 1118	Industrial Electronics I	33
A-ELN 1119	Industrial Electronics II	33
MAT 1115	Electrical Mathematics	55
DFT 1110	Blueprint Reading: Building Trades	33
DFT 1113	Blueprint Reading: Electrical	33
ELC 1155	National Electrical Code (Review)	44

ELECTIVE COURSES

PHY 1101	Applied Science I	55
PHY 1102	Applied Science	55
PHY 1122	Rigging	33
MAT 1116	Electrical Mathematics	55
BUS 1103	Small Business Operations	33

* Apprentices with advanced math credit should select another course.

ELECTRICAL INSTALLATION
RESIDENTIAL, COMMERCIAL & INDUSTRIAL
OE-NCES 17.1401

COURSE DESCRIPTION

No.	Title	Hours
A-ELC 1151	Basic Electricity I	55

A study of the electrical structure of matter and electron theory, the relationship between voltage, current, and resistance in series, parallel, and series-parallel circuits. An analysis of simple current circuits by Ohm's law and a study of the terms of electrical energy that apply to work and power.

To acquaint the learner with conductors and insulators of electricity; wire sizes; voltage drop; types of conduit; fuse rating and current protection; safety and first aid. The apprentice is introduced to the definitions and fundamental rules covered by the National Electric Code. Prerequisite: None.

A-ELC 1152	Basic Electricity II	55

Provides fundamental concepts in single and polyphase alternating current circuits, voltages, currents, power measurements, transformers, and motors. Instruction in the use of electrical test instruments in circuit analysis. The basic concepts of AC and DC machines; simple system controls; principles of transformers and AC motors. General installation provisions permitted by the "Code" for service entrances, over-current devices, grounding and size of conductors, and various electrical systems.
Prerequisites: A-ELC 1151, MAT 1115.

A-ELC 1153	Basic Electricity III	55

This course deals with the fundamentals of alternating current electricity. Topics concerning resistance, capacitance, and inductance are thoroughly studied and related problems are solved by mathematics. Series, parallel and power in alternating circuits are presented with related problems.

The sections of National Electric Code dealing with hazardous installations are discussed. The fundamentals of motor controls are presented.
Prerequisite: A-ELC 1152.

A-ELC 1154 Basic Electricity IV 55
(Wiring Methods--National Electrical Code)

Topics on the National Electrical Code are studied in terms of wiring methods in commercial and industrial installations. Outlets, switches, switchboards, and panelboards along with various control systems and basic electronics are discussed for various installations.
Prerequisite: A-ELC 1153.

A-ELC 1124 Residential Wiring 55

Provides instruction and application in the fundamentals of blueprint reading, planning, layout, and installation of wiring in residential applications such as: services, switchboards, lighting, fusing, wire sizes, branch circuits, conduits, National Electrical Code regulations in actual building mock-ups.
Prerequisites: ELC 1113, DFT 1110.

A-ELC 1125 Commercial and Industrial Wiring 55

Layout, planning, and installation of wiring systems in commercial and industrial complexes, with emphasis upon blueprint reading and symbols, the related National Electrical Codes, and the application of the fundamentals to practical experience in wiring, conduit preparation, and installation of simple systems.
Prerequisites: A-ELN 1118, A-ELC 1124.

A-ELN 1118 Industrial Electronics I 33

Basic theory, operating characteristics, and application of vacuum tubes such as: diodes, triodes, tetrodes, pentodes, and gaseous control tubes. An introduction to amplifiers using triodes, power supplies using diodes, and other basic applications of solid state controls.
Prerequisite: A-ELC 1152.

A-ELN 1119 Industrial Electronics II 33

Basic industrial electronic systems such as: motor controls, alarm systems, heating systems and controls, magnetic amplifier controls, welding control systems using thyratron tubes, and other basic solid state systems commonly found in most industries.
Prerequisite: A-ELN 1118.

MAT 1115 Electrical Mathematics 55

A study of fundamental concepts of algebra; basic operations of addition, subtraction, multiplication, and division; solution of first order equations, use of letters and signs, grouping, factoring, exponents, ratios, and proportions; solution of equations, algebraically and graphically; a study of logarithms and use of tables; an introduction to trigonometric functions and their application to right angles; and a study of vectors for use in alternating current.
Prerequisite: MAT 1101 or equivalent.

DFT 1110 Blueprint Reading: Building Trades 33

Principles of interpreting blueprints and trade specifications common to the building trades. Development of proficiency in making three view and pictorial sketches.
Prerequisite: None.

DFT 1113 Blueprint Reading: Electrical 33

Interpretation of schematics, diagrams and blueprints applicable to electrical installations with emphasis on electrical plans for domestic and commercial buildings. Sketching schematics, diagrams, and electrical plans for electrical installations using appropriate symbols and notes according to the applicable codes will be a part of this course.
Prerequisite: DFT 1110.

ELC 1155 National Electrical Code (Review) 44

This course is set up to supplement all the Basic Electricity Courses which included code lessons concerning laws, rules, and ordinances required for the installation of electrical materials and equipment. The National Electrical Code, state and local agencies are reviewed for various subjects. The student should be brought up to date on the latest revisions. This course should help the journeyman prepare for the state electrical contractors examination.
Prerequisite: A-ELC 1154 and A-ELC 1125.

MAT 1116 Electrical Mathematics 55

In-depth treatment to give a working knowledge of the powers of 10, Ohm's law for series and parallel circuits, quadratic equations, Kirchoff's laws, trigonometric functions, plane vectors, alternating currents, vector algebra and logarithms.
Prerequisite: MAT 1115.

ELECTRICAL LINEMAN
OE-NCES 17.1402

INTRODUCTION

Purpose of Program

Electrical power requirements have multiplied during recent years because of increased industrialization and the construction of homes and public buildings that are maintained by electrical light, heat and power. With this increase in electrical power consumption, additional facilities are required along with additional skilled manpower to install, service and maintain modern equipment.

In order to prepare qualified young men/women to enter the electrical trade as skilled linemen, the following related studies program has been prepared.

The objectives of this program guide is to provide technical information and skills necessary to perform the jobs and operations assigned to the lineman; to teach the proper safety procedures and to establish acceptable work habits; to develop the correct habits and techniques in the use of tools and equipment of the trade; to develop initiative, judgment, and an attitude for accepting individual responsibility in working with people.

Career Opportunities

The lineman erects wood poles and prefabricated light-duty metal towers, cable, and related equipment to construct transmission and distribution powerlines. He may assist in attaching crossarms, insulators, lightning arresters, switches, wire conductors, and auxiliary equipment to poles preparatory to erection. Climbs erected poles or towers and installs equipment such as transformers, lines or cables and other equipment. He/she splices, solders and insulates conductors and related wiring to join sections of powerline and to connect electrical accessories.

Note: Blueprint Reading should be taught in conjunction with the National Electrical Code. See the suggested Program Guide with courses set up separately.

Note: This related program has been used since 1964. Designed to be taught by one instructor. The Instructors Manual and Assignment Sheets have been furnished by the Program Development Division. This program was State approved and sponsored by the Carolinas Chapter of the National Electrical Contractors Association.

	Approx. Hours
ORIENTATION AND SAFETY	22
MATHEMATICS	
Fundamental Operations-Fractions, etc.	10
Decimals and Percentage	10
Powers and Roots, Ratio and Proportion	20
Formulas and Their Applications	20
Applied Trigonometry, Wire Calculations, etc.	20
TOTAL	80
BLUEPRINT READING AND SKETCHING	
Fundamentals and 3-View Sketching	8
Reading Domestic Plans	30
Reading Commercial & Industrial Plans	40
Using Electrical Diagrams to Take Off Quantities	7
TOTAL	85

NATIONAL ELECTRICAL CODE
(Wiring Methods-54 Topics)

FUNDAMENTALS OF ELECTRICITY
(Theory, Technical Information and Applied Mathematics)

ELECTRICAL TRADES

PUBLIC UTILITIES

ELECTRICAL LINEMAN
OE-NCES 17.1402

COURSE DESCRIPTIONS

No. **Title** **Hours**

A-ELC 1131 Electrical Lineman: Theory and Application I 44

Instruction is given in elements of electricity; magnetism, static electricity, cells and batteries, the electric circuit, parallel and series circuits. The student becomes acquainted with the basic tools and materials used in this trade. Identification and use of line hardware and fittings; sorting and distribution of materials, framing poles, assembly and installation of hardware, insulators, and crossarms.
Prerequisite: None.

A-ELC 1132 Electrical Lineman: Theory and Application II 44

The student receives training in pole climbing and learning the correct techniques and safe practices in manipulating tools above the ground. Installation of secondary crossarms, insulators and guys, and hanging of the distribution transformer while working on the pole. Secondary light and power transformer connections, wire splices, stringing of secondary lines, use and understanding of power standards.
Prerequisite: A-ELC 1131.

A-ELC 1133 Electrical Lineman: Theory and Application III 44

Training is given in checking loads on transformers, trouble shooting, rigging methods, ropes and knots; street light practices, repairing and replacing electrical apparatus, circuits, lamps, glassware, refractors, control of street lights, trouble shooting regulations and safety practices. A study of transformers, types, construction, markings, connections, oil, insulation, cooling, loading and testing; operating orders and clearances; general information needed for string standards and tower line assemblies.
Prerequisite: A-ELC 1132.

A-ELC 1134 Electrical Apparatus 44

This course deals with the basic electrical apparatus used in the line trade. Instruction will be given in use of transformers, regulators, switches, capacitors, sectionalizers, breakers, arrestors, cutouts and fuses. Laboratory experiences with this equipment will supplement classroom theory.
Prerequisite: A-ELC 1132.

ELC 1141 First Aid 22

This is a standard American Red Cross emergency first aid course. It deals with emergency first aid and safe working practices applied to the Electrical Lineman. It is designed to qualify each student for a Red Cross First Aid Card.
Prerequisite: None.

ELC 1142 First Aid--Advanced 22

This is the advanced American Red Cross emergency first aid course. It deals with field practices of first aid for the electrical lineman. It is designed to qualify each student for the advanced Red Cross First Aid Card.
Prerequisite: ELC 1141.

ELC 1143 Electrical Safety Codes 22

This is a study and interpretation of the state and national safety codes for outside poles, structures and line construction.
Prerequisite: None.

ELC 1144 Electrical Safety Codes 22

A continued study of Electrical Safety Codes for installation and repair of outside poles, structures and lines.
Prerequisite: ELC 1142.

DFT 1120 Blueprint Reading: Maps and Sketches 22

Interpretation and reading of maps, sketches, blueprints used by the electrical lineman. Information is covered on the basic principles of lines, views, dimensioning procedures, notes, symbols basic to graphic illustrations. The student is required to prepare sketches and maps of a typical line system.
Prerequisite: None.

MAT 1122 Electrical Mathematics 33

This course provides practical problem material for electrical students with an introduction to algebraic formulas, plane geometry and elementary trigonometry. Emphasis is placed on applications of problems which are arranged in the natural order of dependence of one topic on the next.
Prerequisite: MAT 1101.

AIR CONDITIONING
OE-NCES 17.0100

INTRODUCTION

Purpose of Program

In recent years the use of air conditioning equipment has increased tremendously. Practically all new building construction for business and commercial use have "all year" comfort systems. Many homes now have air conditioning and the trend is toward greater use of "all year" systems of cooling and heating. With this great upswing in the use of air conditioning, a greater demand is made on trained personnel to install, operate, maintain and service this equipment.

This curriculum is designed to give students practical knowledge that will enable them to become capable service men in the industry. The principle objective has been to outline the required technical and related instruction to enable them to understand the basic principles involved in the construction, operation, and maintenance of equipment.

Career Opportunities

Job opportunities exist with companies that specialize in air conditioning, automatic heating and sheet metal. The service man is employable in areas of sales, maintenance and installation.

AIR CONDITIONING
OE-NCES 17.0100

REQUIRED BASIC COURSES

No.	Title	Hours
ENG 1101	Reading Improvement	22
ENG 1102	Communication Skills	33
MAT 1101	Fundamentals of Mathematics	55
MAT 1102	Algebra	55
PHY 1101	Applied Science	55
PSY 1101	Human Relations	33
ISC 1001	Industrial Safety	33
BUS 1103	Small Business Operations	33

REQUIRED RELATED COURSES

A-AHR 1123	Principles of Air Conditioning	55
A-AHR 1128	Automatic Controls	55
A-AHR 1124	Air Conditioning Servicing	55
A-AHR 1126	All Year Comfort Systems	55
A-MEC 1120	Duct Construction and Maintenance	55
A-DFT 1104	Blueprint Reading	33
A-DFT 1116	Blueprint Reading: Air Conditioning	33
A-ELC 1102	Applied Electricity	33
A-WLD 1101	Basic Gas Welding	33

ELECTIVE COURSES

A-AHR 1109	Job Planning and Estimating	22
A-AHR 1116	Oil Burner Installation and Service	55
A-AHR 1117	Gas Burners, Electric Heat and Liquid Heat Applications	55

SERVICE TRADES

AIR CONDITIONING
OE-NCES 17.0100

COURSE DESCRIPTIONS

No. Title Hours

A-AHR 1123 Principles of Air Conditioning 55

Work includes the selection of various heating, cooling and ventilating systems, investigation and control of factors affecting air cleaning, movement, temperature, and humidity. Use is made of psychrometric charts in determining needs to produce optimum temperature and humidity control. Commercial air conditioning equipment is assembled and tested. Practical sizing and balancing of ductwork is performed as needed.
Prerequisite: AHR 1122.

A-AHR 1128 Automatic Controls 55

Types of automatic controls and their function in air conditioning systems. Included in the course will be electric and pneumatic controls for domestic and commercial cooling and heating; zone controls, unit heater and ventilator controls, commercial fan systems controls, commercial refrigeration controls, and radiant panel controls.
Prerequisite: ELC 1102, AHR 1122.

A-AHR 1124 Air Conditioning Servicing 55

Emphasis is placed on the installation, maintenance, and servicing of equipment used in the cleaning, changing, humidification and temperature control of air in an air conditioned space. Installation of various ducts and lines needed to connect various components is made. Shop work involved burner operation, controls, testing and adjusting of air conditioning and refrigeration equipment, and location and correction of equipment failure.
Prerequisite: AHR 1123.

A-AHR 1126 All Year Comfort Systems 55

Auxiliary equipment used in conjunction with refrigeration systems to provide both heating and cooling for "all year" comfort will be studied and set up in the laboratory. Included will be oil fired systems, gas fired systems, water circulating systems, and electric-resistance systems. Installation of heat pumps will be studied along with servicing techniques. Reversing valves, special types of thermostatic expansion valves, systems of de-icing coils, and electric wiring and controls are included in the study.
Prerequisites: AHR 1123, AHR 1128.

A-MEC 1120 Duct Construction and Maintenance 55

Study of various duct materials including sheet steel, aluminum, and fiber glass. Safety, sheet metal hand tools, cutting and shaping machines, fasteners and fabrication practices, layout methods, and development of duct systems. The student will service various duct systems and perform on the site repairs including ducts made of fiber glass. A study is made of duct fittings, dampers and regulators, diffusers, heater and air washers, fans, insulation and ventilating hoods.
Prerequisites: DFT 1116, AHR 1123.
Corequisite: AHR 1126.

A-DFT 1104 Blueprint Reading 33

Interpretation and reading of blueprints. Information on the basic principles of the blueprint; lines, views, dimensioning procedures and notes.
Prerequisite: None.

A-DFT 1116 Blueprint Reading: Air Conditioning 33

A specialized course in drafting for the heating, air conditioning and refrigeration student. Emphasis will be placed on reading of blueprints that are common to the trade; blueprints of mechanical components, assembly drawings, wiring diagrams and schematics, floor plans, heating system plans including duct and equipment layout plans, and shop sketches. The student will make tracings of floor plans and layout air conditioning systems.
Prerequisite: DFT 1122.

A-ELC 1102 Applied Electricity 33

The use and care of test instruments and equipment used in servicing electrical apparatus for air conditioning and refrigeration installations. Electrical principles and procedures for trouble-shooting of the various electrical devices used in air conditioning, heating, and refrigeration equipment. Included will be transformers, various types of motors and starting devices, switches, electrical heating devices and wiring.
Prerequisite: PHY 1101.

A-WLD 1101 Basic Gas Welding 33

Welding demonstrations by the instructor and practice by students in the welding shop. Safe and correct methods of assembling and operating the welding equipment. Practice will be given for surface welding, bronze welding, silver soldering, and flame-cutting methods applicable to mechanical repair work.
Prerequisite: None.

A-AHR 1109 Job Planning and Estimating 22

Specifications, study of prints, notations and synopsis of material cost. Synopsis of labor cost, listing of equipment and material take-off, labor take-off, subcontractor estimates, duct system estimate (poundage method) overhead costs, and estimate of job.
Prerequisite: None.

A-AHR 1116 Oil Burner Installation and Service 55

Burner fundamentals, high-pressure gun-type burners, pressure regulating valves, nozzles, fans and air control devices, low-pressure atomization burners, rotary burners, vaporization pot-type burners, thermostats, pressure burner controls, vaporizing burner controls. Service and maintenance.
Prerequisite: None.

A-AHR 1117 Gas Burners, Electric Heat, and Liquid Heat Applications 55

Gas heating devices, atmospheric injection burners, power burners, gas venting, mili-amp thermostatic controls, electric resistance heating units, duct furnances, steam, unit coil hook-up, hot water, installation of coil.
Prerequisite: None.

SERVICE TRADES APPRENTICESHIP

REFRIGERATION
OE-NCES 17.3000

INTRODUCTION

Purpose of Program

In recent years the use of refrigeration equipment has increased tremendously. The food industry is requiring greater use of refrigeration systems in freezing, storage, and display of products. With this great upswing in the use of refrigeration equipment, a greater demand is made on trained personnel to install, operate, maintain and service this equipment.

This curriculum is designed to give the students practical knowledge that will enable them to become capable service men in the industry. The principle objective has been to outline the required technical and related instruction to enable them to understand the basic principles involved in the construction, operation, and maintenance of equipment.

Career Opportunities

Job opportunities exist with companies that specialize in residential and commercial refrigeration installation and service. The service man is employable in areas of sales, maintenance, installation and in the growing field of truck and trailer refrigeration.

Refrigeration
OE-NCES 17.3000

REQUIRED BASIC COURSES

No.	Title	Hours
ENG 1101	Reading Improvement	22
ENG 1102	Communication Skills	33
MAT 1101	Fundamentals of Mathematics	55
MAT 1102	Algebra	55
PHY 1101	Applied Science	55
PSY 1101	Human Relations	33
ISC 1001	Industrial Safety	33
BUS 1103	Small Business Operations	33

REQUIRED RELATED COURSES

A-AHR 1103	Refrigeration Servicing	55
A-AHR 1121	Principles of Refrigeration	55
A-AHR 1122	Domestic and Commercial Refrigeration	55
A-AHR 1128	Automatic Controls	55
A-DFT 1104	Blueprint Reading	33
A-ELC 1102	Applied Electricity	55
A-WLD 1107	Basic Welding and Soldering	44

ELECTIVE COURSES

A-ELC 1161	Basic Electricity/Electronics	55
A-MEC 1252	Coin and Currency Changers	55
A-MEC 1253	Mechanical Vending Machines	55

REFRIGERATION
OE-NCES 17.3000

COURSE DESCRIPTIONS

No. Title Hours

A-AHR 1103 Refrigeration Servicing 55

The students receive experiences in testing, troubleshooting, adjusting, removing, and installing component parts. They remove refrigerants and use vacuum pumps. They add refrigerants by using charging cylinders and gauges. Safety rules are observed in all operations.
Prerequisite: None.

A-AHR 1121 Principles of Refrigeration 55

An introduction to the principles of refrigeration, terminology, the use and care of tools and equipment, and the identification and the function of the component parts of a system. Other topics to be included will be the basic laws of refrigeration; characteristics and comparison of the various refrigerants; the use and construction of valves, fittings, and basic controls. Practical work includes tube bending, flaring and soldering. Standard procedures and safety measures are stressed in the use of special refrigeration service equipment and the handling of refrigerants.
Prerequisite: None.

A-AHR 1122 Domestic and Commercial Refrigeration 55

Domestic refrigeration servicing of conventional, hermetic, and absorption systems. Cabinet care, controls, and system maintenance in domestic refrigerators, freezers, and window air conditioning units is stressed. Commercial refrigeration servicing of display cabinets, walk-in cooler and freezer units, and mobile refrigeration systems is studied. The use of manufacturers' catalogs in sizing and matching system components and a study of controls, refrigerants, servicing methods is made. The American Standard Safety Code for Refrigeration is studied and its principles practiced.
Prerequisite: AHR 1121.

A-AHR 1128 Automatic Controls 55

Types of automatic controls and their function in air conditioning systems. Included in the course will be electric and pneumatic con-

trols for domestic and commercial cooling and heating; zone controls, unit heater and ventilator controls, commercial fan systems controls, commercial refrigeration controls, and radiant panel controls.
Prerequisite: ELC 1102, AHR 1122.

A-DFT 1104 Blueprint Reading 33

Interpretation and reading of blueprints. Information on the basic principles of the blueprint; lines, views, dimensioning procedures and notes.
Prerequisite: None.

A-ELC 1102 Applied Electricity 55

The use and care of test instruments and equipment used in servicing electrical apparatus for air conditioning and refrigeration installations. Electrical principles and procedures for trouble-shooting of the various electrical devices used in air conditioning, heating, and refrigeration equipment. Included will be transformers, various types of motors and starting devices, switches, electrical heating devices and wiring.
Prerequisite: PHY 1101.

A-WLD 1107 Basic Welding and Soldering 44

Welding and soldering demonstrations by the instructor and practice by students using equipment to join metal, make pipe and tube connections and to solder wire terminals. Silver soldering is used to join pipe and make connections or refrigeration units and plumbing installations. All work is performed using rules to practice good safety methods.
Prerequisite: None.

A-ELC 1161 Basic Electricity/Electronics 55

A study of the basic electrical/electronics principles and components needed for trouble-shooting of the various devices used on modern machines designed to serve special purposes. A basic study is made of alternating current and electrical distribution in series and parallel circuits. The students become familiar with the following electrical terms: insulators, conductors, semi-conductors, coils, relays, solenoids and polarity. Safety with the use of electricity and electrical devices is stressed at all times.
Prerequisite: None.

A-MEC 1252 Coin and Currency Changers 55

The students study the principles, functions, adjustments and the repair of coin rejectors, acceptors, and changers. A basic knowledge of the operation and maintenance of the several types of currency changers is required.
Prerequisite: None.

A-MEC 1253 Mechanical Vending Machines 55

This course consists of the removing, adjusting and replacing of the component parts of the machines for proper operation. Typical mechanical vending equipment; candy, cigarette, hot food, pastry and snack machines. A complete knowledge of each machine, along with the proper safety practices involved is necessary.
Prerequisite: None.

MACHINIST
OE-NCES 17.2303-1

INTRODUCTION

Purpose of Program

This program guide was prepared to meet a definite need for training of machinists. Surveys recently completed in North Carolina show that many of the existing industries lack time and facilities for training enough machinists to meet present and planned needs. Expanding industries already located in our State and new industries under development invariably express the need for skilled craftsmen who have the background knowledge and potential to advance.

This guide is designed to give learners the opportunity to acquire on-the-job skills and the related technical information necessary to build a profitable career in the machine shop industry in the State. It is comprised of the joint views of committees responsible for its development.

Career Opportunities

The machinist is a skilled metal worker who shapes metal parts by using machine tools and hand tools, His/her training and experience enable him/her to plan and carry through all the operations needed in turning out a machined product and to switch readily from one kind of product to another. A machinist is able to select the proper tools and material required for each job and to plan the cutting and finishing operations in their proper order so that he can complete the finished work according to blueprint or written specifications. He/she makes standard shop computations relating to dimensions of work, tooling, feeds, and speeds of machining. He/she often uses precision measuring instruments such as micrometers and gages to measure the accuracy of his/her work to thousandths of an inch.

This skilled worker must be able to set up and operate most types of machine tools. The machinist also must know the composition of metals so that he/she can heat and quench cutting tools and parts to improve machinability. His/her wide knowledge enables him/her to turn a block of metal into an intricate, precise part.

MACHINIST
OE-NCES 17.2303-1

REQUIRED BASIC COURSES

No.	Title	Hours
ENG 1101	Reading Improvement	22
ENG 1102	Communication Skills	33
ISC 1101	Industrial Safety	33
PSY 1101	Human Relations	33
BUS 1103	Small Business Operations	33
MAT 1101	Fundamentals of Mathematics	55

REQUIRED RELATED COURSES

MAT 1103	Geometry	33
MAT 1104	Trigonometry	33
MAT 1123	Machinist Mathematics	33
DFT 1104	Blueprint Reading	33
DFT 1105	Blueprint Reading: Mechanical	33
DFT 1106	Blueprint Reading: Mechanical	33
PHY 1101	Applied Science	55
PHY 1102	Applied Science	55
A-MEC 1115	Treatment of Ferrous Metals	33
A-MEC 1116	Treatment of Non-Ferrous Metals	33
A-MEC 1126	Metallurgy - Heat Treating Practices	33
A-MEC 1101	Machine Shop Theory and Practice	33
A-MEC 1102	Machine Shop Theory and Practice	33
A-MEC 1103	Machine Shop Theory and Practice	33
A-MEC 1104	Machine Shop Theory and Practice	33

ELECTIVE COURSES

A-DFT 1121	Drafting	66
A-DFT 1122	Drafting	66
A-DFT 1131	Mechanical Drafting	66
A-DFT 1132	Mechanical Drafting	66
ELC 1101	Basic Electricity	22
BUS 1105	Industrial Organizations	33
MEC 1140	Hydraulics - Fundamentals	33
WLD 1104	Basic Welding and Cutting	33

MACHINIST
OE-NCES 17.2303-1

COURSE DESCRIPTIONS

No.	Title	Hours
MAT 1123	Machinist Mathematics	33

Introduces gear ratio, lead screw and indexing problems with emphasis on application to the machine shop. Practical applications and problems furnish the trainee with experience in geometric propositions and trigonometric relations to shop problems; concludes with an introduction to compound angle problems.
Prerequisite: MAT 1104.

DFT 1104 Blueprint Reading 33

Interpretation and reading of blueprints. Information on the basic principles of the blueprint; lines, views, dimensioning procedures and notes.
Prerequisite: None.

DFT 1105 Blueprint Reading: Mechanical 33

Further practice in interpretation of blueprints as they are used in industry; study of prints supplied by industry; making plans of operations; introduction to drafting room procedures; sketching as a means of passing on ideas, information and processes.
Prerequisite: DFT 1104.

DFT 1106 Blueprint Reading: Mechanical 33

Advanced blueprint reading and sketching as related to detail and assembly drawings used in machine shops. The interpretation of drawings of complex parts and mechanisms for features of fabrication, construction and assembly.
Prerequisite: DFT 1105.

A-MEC 1115 Treatment of Ferrous Metals 33

Investigates the properties of ferrous metals and tests to determine their uses. Instructions will include some chemical metallurgy to provide a background for the understanding of the physical changes and causes of these changes in metals. Physical metallurgy of ferrous metals, producing iron and steel, theory of alloys, shaping and forming, heat treatments for steel, surface treatments, alloy of special steel, classification of steels, and cast iron will be topics for study.
Prerequisite: None.

A-MEC 1116 Treatment of Non-Ferrous Metals 33

Continuation of the study of physical metallurgy. The non-ferrous metals: bearing metals, (brass, bronze, lead), light metals (aluminum and magnesium), and copper and its alloys are studied. Powder metallurgy, titanium, zirconium, indium, vanadium, and also plastics are included in this course.
Prerequisite: MEC 1115.

A-MEC 1126 Metallurgy - Heat Treating Practices 33

Working knowledge of the methods of treating ferrous and nonferrous metals. The effects of hardening, tempering, and annealing upon the structure and physical properties of metals. Trainees will be given the opportunity to acquaint themselves with the equipment and processes of heat treating.
Prerequisite: MEC 1124.

A-MEC 1101 Machine Shop Theory and Practice 33

An introduction to the machinist trade and the potential it holds for craftsmen. Deals primarily with the identification, care and use of basic hand tools and precision measuring instruments. Elementary layout procedures and processes of lathe, drill press, grinding (off-hand) and milling machines will be introduced in theory only.
Prerequisite: None.

A-MEC 1102 Machine Shop Theory and Practice 33

Advanced operations in layout tools and procedures, power sawing, drill press, surface grinder, milling machine shaper. The student will study the basic operations on the cylindrical grinder and will select tools and procedures to be used.
Prerequisite: A-MEC 1101.

A-MEC 1103 Machine Shop Theory and Practice 33

Advanced work on the engine lathe, turning, boring and threading machines, grinders, milling machine and shaper. Introduction to basic indexing and terminology with additional processes on calculating, cutting and measuring of spur, helical, and worm gears and wheels. The trainee will use precision tools and measuring instruments such as vernier height gauges, protractors, comparators, etc. Basic procedures for exercises will be given for use on the turret lathe and on the tool and cutter grinder.
Prerequisite: A-MEC 1102.

A-MEC 1104 Machine Shop Theory and Practice 33

Development of class projects using previously learned procedures in planning, blueprint reading, machine operations, final assembly and inspection. Additional processes on the turret lathe, tool and cutter grinder, cylindrical and surface grinder, advanced milling machine operations, etc. Special procedures and operations, processes and equipment, observing safety procedures faithfully and establishing of good work habits and attitudes acceptable to the industry.
Prerequisite: A-MEC 1103.

A-DFT 1121 Drafting 66

An introduction to drafting and the study of drafting practices. Instruction is given in the selection, use and care of instruments, single-stroke lettering, applied geometry, freehand sketching consisting of orthographic and pictorial drawings. Orthographic projection, reading and instrument drawing of principal views, single auxiliary views (primary), and double (oblique) auxiliary views will be emphasized. Dimensioning and note practices will be studied with reference to the American Standards Association practices. Methods of reproducing drawings will be included at the appropriate time.
Prerequisite: None.

A-DFT 1122 Drafting 66

The trainee will study simple and successive revolutions and their applications to practical problems. Sections and conventions will be studied and both detail and assembly sections will be drawn. Intersections and developments will be studied by relating the drawing to the sheet metal trades. Models of the assigned drawings will be made from construction paper, cardboard, or similar materials as a proof of the solution to the problems drawn.

Methods of drawing and projecting axonometric, oblique, and perspective drawings will be studied with emphasis on the practical applications of pictorial drawings. Various methods of shading will be introduced and dimensioning and sectioning of oblique and axonometric pictorials will be done.
Prerequisite: DFT 1121.

A-DFT 1131 Mechnaical Drafting 66

An introduction to mechanical drafting beginning with problems concerning precision and limit dimensioning. Methods of fastening materials, and fasteners: keys, rivets, springs, and welding. Symbols will be studied and drawings will be made involving these items. Principles of design will be introduced with the study of basic mechanisms of motion transfer; gears, cams, power trains, pulleys, belting and methods of specifying and calculating dimensions will be studied. Drawings will be made involving these mechanisms.
Prerequisite: DFT 1122.

6 5

A-DFT 1132 Mechanical Drafting 66

Principles of design sketching, design drawings, layout drafting, detailing from layout drawings, production drawings and simplified drafting practices constitute areas of study. Forging and casting drawings will be made from layouts. Specifications, parts list and bill of materials are emphasize in this course. The student will develop a complete set of working drawings of a tool, jig, fixture or simple machine and learn principles of design, handbook and manual usage.
Prerequisite: DFT 1131.

ELC 1101 Basic Electricity 22

This course covers the elementary principles of electricity, including units and terms, Ohm's Law, power, and types of electricity with specific application to the operation of electrical devices.
Prerequisite: None.

MEC 1140 Hydraulics - Fundamentals 33

This course is arranged to give the student a general knowledge of the basic components of hydraulic systems, as well as a general understanding of the basic laws and formulas used in simple hydraulic calculations. Course covers such topics as pumps, control valves, control assemblies, actuators the use of standard hydraulic symbols and basic maintenance procedures.
Prerequisite: None.

WLD 1104 Basic Welding and Cutting 33

Welding demonstrations by the instructor and practice by students in the welding shop. Safe and correct methods of assembling and operating the welding equipment. Practice will be given for surface welding; bronze welding, silver soldering, arc and gas-arc welding methods applicable to mechanical repair work.
Prerequisite: None.

TOOL AND DIE MAKING
OE-NCES 17.2302-1

INTRODUCTION

Purpose of Curriculum

Mass production depends upon a steady flow of parts that have all been made to the same specifications. These parts may have been produced by machines which complete a repetitive cycle of operations, or they may have been produced by punching or stamping them into the required sizes and shapes. It is the responsibility of the tool and die maker to produce the special tools and fixtures for these machining operations. He/she may also produce the gauges and the other inspection tools used in checking machined parts. Many short-cut production methods were developed during the past two decades, and production was thus speeded up because of the special tooling, dies, jigs, and fixtures which were produced by tool and die makers. Industry is constantly using these short-cut production methods, especially since automatic machines have been introduced.

To complete this training successfully, a student should have a high school diploma or its equivalent. He/she should have a good knowledge of mathematics and be able to use his/her hands skillfully in the manipulation of tools. He/she should be a selected graduate from a recognized machinist program or an indentured apprentice program or present proof of equivalent work experience.

Career Opportunities

A tool and die maker analyzes a variety of specifications, lays out metal stock, sets up and operates machine tools. He/she fits and assembles parts to make and repair metal working dies, cutting tools, jigs, fixtures, gauges, and machinists' handtools. He/she computes dimensions, decides on machining to be done, and plans layout and assembly operations.

Typical jobs which he/she might secure in the manufacturing field include: toolmaker, diemaker, tool repairman, tool (set-up) man, and tool inspector.

TOOL AND DIE MAKING
OE-NCES 17.2302-1

REQUIRED BASIC COURSES (PREREQUISITE)

To complete this training successfully, a student should have a high school diploma or its equivalent. He should have a good knowledge of mathematics and be able to use his hands skillfully in the manipulation of both hand and machine tools. He/she should be a selected graduate from a recognized machinist program or have equivalent work experience. In the event an applicant has not completed all the required basic courses of the Machinist Curriculum, he/she should enroll for these subjects. This will qualify the apprentice to continue his work and become a Tool and Die Maker journeyman.

REQUIRED RELATED COURSES

No.	Title	Hours
MAT 1105	Trigonometry-Survey & Applications	33
MAT 1106	Trigonometry-Compound Angles, etc.	33
A-MEC 1151	Tool Making-Jig & Fixtures	44
A-MEC 1152	Tool Making -Gages & Special Tools	44
A-MEC 1153	Tool Making-Advanced	44
A-MEC 1154	Die Making I - Principles	44
A-MEC 1155	Die Making II - Methods of Design, etc.	44
A-MEC 1156	Die Making III - Progressive Dies	44
A-MEC 1157	Tool Design for Production	33
A-MEC 1158	Introduction to Plastic Molds	22
A-MEC 1159	Print Reading & Inspection	22
A-MEC 1160	Special Problems (Tool & Die)	33
A-MEC 1161	Production Practices	33

ELECTIVE COURSES

A-ELC 1103	Electricity (Industrial Machines)	22
A-MEC 1140	Hydraulics-Fundamentals	33
A-MEC 1162	Tool & Die Making (Review)	33
A-MEC 1163	Tool & Die Machine (Survey)	33
A-MEC 1170	Tool Design - Advanced	66
A-MEC 1171	Die Design and Diesinking Methods	66

METALWORKING OCCUPATIONS

MANUFACTURING AND MACHINING

TOOL AND DIE MAKER
OE-NCES 17.2302-1

COURSE DESCRIPTIONS

No.	Title	Hours
MAT 1105	Trigonometry - Survey & Applications	33

A review of trigonometric functions and tables and solution of problems involving right triangles. Problem solving by resolving figures into right triangles and relationships between trigonometric functions. Solutions of oblique triangles, the sine and cosine laws, problems involving tapers, the sine bar, precision discs, taper plus gages, angles, and circular arcs.
Prerequisite: MAT 1104.

No.	Title	Hours
MAT 1106	Mathematics: Compound Angles, etc.	33

This course consists basically of the fundamentals of solid geometry and trigonometry of compound angles, problems solving from pictoral drawings of compound angular holes, tilting angles and angles of rotation, and problems having tool and die application.
Prerequisites: MAT 1103, MAT 1104, and MAT 1105.

No.	Title	Hours
A-MEC 1151	Tool Making: Jigs & Fixtures	44

This course is designed to help the student become more proficient in working to very close tolerances. The student will learn the best methods of fastening parts together, clamping and locating methods, and the application of jigs and fixtures to production machining. Emphasis is stressed throughout on the quality of workmanship and precision tolerances.
Prerequisites: A-MEC 1104; A-DFT 1106 and DFT 1121 or equivalent.

No.	Title	Hours
A-MEC 1152	Tool Making: Gages and Special Tools	44

A study of precision gages will be made. Special tools and their application to production are studied, such as making plug gages, ring gages, snap gages, etc. The student will write the procedure for making of special projects, such as, slide tools, form tools, and fly cutters.
Prerequisite: A-MEC 1151.

A-MEC 1153 Advanced Tool Making 44

A continuation of tool making practices. On-the-job project work will be planned which consist of complicated jigs and fixtures, including pneumatic operated fixtures and power clamping methods. Further instruction given in form grinding and form dressing procedures, surface finishes, precision tolerances, and general tool making practices.
Prerequisite: A-MEC 1152.

A-MEC 1154 Die Making I 44

This course is designed to introduce the student to the principles of Dies and Die Making. Simple piercing and blanking dies will be studied and the student acquainted with terminology common to the trade. Accuracy, surface finish, importance of clearances, radiuses and the press cycle will be studied. Student will build and set up for production a simple die, working from blueprints and maintaining specified accuracy.
Prerequisite: Machinist Trade Diploma or equivalent.

A-MEC 1155 Die Making II 44

A continuation of the study of dies, the dangers of insufficient and excessive cutting clearances, and methods of providing angular clearances. Factors affecting stripping force will be discussed along with bending stresses, deformation due to bending and the bend allowance curve. Student will write a procedure to build a form and bending die. Development of correct working habits and close tolerance machining is stressed.
Prerequisite: A-MEC 1154.

A-MEC 1156 Die Making III 44

The theory and design of progressive dies will be studied. The student will be given instruction in the location of pilots, the progressive cam stages, grinding operations, and blank development. The student will machine, assemble, and set up a conventional progressive die involving three or more stages. Further theory and practice is given in plastic molds.
Prerequisite: A-MEC 1155.

A-MEC 1157 Tool Design for Production 33

This course will enable the student to plan the process of production and isolate the areas that must be tooled for production. Cost of tools, die work, jig and fixtures, and gaging will be considered. Students will review available items from vendors and utilize standard bushing charts and other references. Typical tool design procedures will be employed and prints must reflect standard procedures.
Prerequisite: Required Related T & D Courses or Equivalent.

A-MEC 1158 Introduction to Plastic Molding 22

Due to the expanding use of plastics, the need for mold making has greatly increased. This course is designed to acquaint the student with the design and construction of simple molds, differences between molds and dies, surface finishes, closures, gates and runners, and ejection methods. Methods of cooling will also be discussed and the student will build a simple mold to prescribed accuracy and finish.
Prerequisite: Required Related T & D Courses or Equivalent.

A-MEC 1159 Blueprint Reading and Inspection 22

This course is to enable the tool and die student to correctly interpret the more complicated die drawings. Methods of machining complicated parts will be discussed and lab practice for inspection of die components will be held.
Prerequisite: DFT 1106.

A-MEC 1160 Special Problems (Tool and Die) 33

This course consists of projects that present problems as to machining methods and cost. Special projects will be presented in jig boring and duplicator work, short life jigs and welding fixtures and special angle radius and circular problems; field trips, to acquaint the student more fully with needs for production tooling, will be a part of this course.
Prerequisite: All basic courses & equivalent.

A-MEC 1161 Production Practices 44

Survey of machines and equipment used in Tool and Die production. Construction, care, and safe use of these machine tools. Types of operations performed on various machines, attachments, and holding devices. The application of handbooks to production problems; analysis of operations required; material handling, flow charts, design of tools, jigs, fixtures, etc. A written report with sketches of the production planning required of a selected product to be produced.
Prerequisite: Required Related T & D Courses or Equivalent.

A-ELC 1103 Electricity (Industrial Machines) 22

The fundamentals of basic electricity (direct and alternating current) are reviewed with work on the following topics: series and parallel circuits, electrical power and energy, wire sizes, magnetism, and the principles of motors, generators and transformers. Single-phase and three-phase circuits, and synchronous motor operation are discussed.
Prerequisite: ELC 1101 and PHY 1101.

33

A-MEC 1140 Hydraulics - Fundamentals 33

This course is arranged to give the student a general knowledge of the basic components of hydraulic systems, as well as a general understanding of the basic laws and formulas used in simple hydraulic calculations. Course covers such topics as the use of standard hydraulic symbols, pumps, control valves, control assemblies, actuators and basic maintenance procedures.
Prerequisite: None.

A-MEC 1162 Tool & Die Making (Review) 33

This is a course in tool and die making, which is an advanced study of the machinist trade. It consists of related technical theory in the building of tool jigs and fixtures, gages, forging dies, plastic dies and die casting, and also the set up of dies for punch press operation. It solves problems involving algebra, geometry, and trigonometry fundamentals as applied to the building of the above mentioned tools and dies. Emphasis is placed on the technical knowledge and use of precision instruments such as comparators, electrowave inspection, gage inspection, and metallurgy, etc.
Prerequisite: Required Related T & D Courses or Equivalent.

A-MEC 1163 Tool & Die Machine (Survey) 33

This course is designed to introduce the student to the tools, instruments, and machines used in the tool and die shop. The student will compare the machines used in production with those used in tool and die making. The student will become familiar with jigs and fixtures and their applications pertaining to production machining.
Prerequisite: Machinist Trade Diploma or Equivalent.

A-MEC 1170 Tool Design - Advanced 66

This is a high-level study of the planning and designing of production tools. It includes the technical, production and economic considerations necessary in the design of jigs, fixtures, gages, and light dies. Actual problems for production are solved, and practical designs produced following the same principles and procedures now being used in industry.
Prerequisite: All Tool & Die courses.

A-MEC 1171 Die Design & Diesinking Methods 66

A course designed to meet the needs of tool and die makers who wish to specialize or gain additional knowledge and practice in the field of die designing. The practical work consists of designing, laying out, and drawing some of the more common types of dies, such as, pierce and blank, progressive and compound, and form and draw dies.
Prerequisite: DFT 1132 and MAT 1106.
All Tool and Die courses.

METAL FABRICATION
OE-NCES 17.2304

INTRODUCTION

Purpose of Curriculum

The purpose of this curriculum is to provide students with a basic knowledge and training for entry-level positions in the metal trades industry. Labor forecasts indicate that there will be a nationwide need for some quarter of a million individuals skilled in the metal trades during the current decade. Upon completion of this curriculum the graduate should be able to enter the labor market with basic skills that would allow him/her to accept employment in industry, construction, metal trades, heating and air conditioning, basic sheet metal trades, and welding.

Career Opportunities

The metal fabricator must be able to function in a number of situations. Generally, he/she is able to fabricate and assemble structural metal parts according to job order or blueprints. He/she may develop layout and plan the sequence of the job operation, applying his/her knowledge of stock allowances for the thickness, shrinkage, and physical properties of metal. He/she must be able to set up and operate fabricating machines such as brakes, rolls, shears, drill press, angle iron bender, and various welding machines. A thorough knowledge of welding and heating of workpieces is required.

METAL FABRICATION
OE-NCES 17.2304

REQUIRED BASIC COURSES

No.	Title	Hours
ENG 1101	Reading Improvement	22
ENG 1102	Communication Skills	33
MAT 1101	Fundamental of Mathematics	55
ISC 1101	Industrial Safety	33
PSY 1101	Human Relations	33
BUS 1101	Small Business Operations	55

REQUIRED RELATED COURSES

A-DFT 1104	Blueprint Reading	22
A-DFT 1117	Blueprint Reading: Welding	44
A-MEC 1113	Shop Processes	33
A-MEC 1120	Duct Construction and Maintenance	44
A-MEC 1124	Metallurgy	33
A-MEC 1105	Structural Fabrication	55
A-MEC 1141	Sheet Metal I	44
A-MEC 1142	Sheet Metal II	44
A-MEC 1145	Measurement and Layout	33
A-WLD 1120	Oxyacetylene Welding and Cutting	44
A-WLD 1121	Arc Welding	44

ELECTIVE COURSES

BUS 1105	Industrial Organization	33
PHY 1101	Applied Science	55
PHY 1102	Applied Science	55
A-MEC 1143	Sheet Metal III	44

METAL FABRICATION
OE-NCES 17.2304

COURSE DESCRIPTIONS

No. Title Hours

A-DFT 1104 Blueprint Reading 22

Interpretation and reading of blueprints. Information on the basic principles of the blueprint; lines, views, dimensioning procedures, and notes.
Prerequisite: None.

A-DFT 1117 Blueprint Reading: Welding 44

A thorough study of trade drawings in which welding procedures are indicated. Interpretation, use and application of welding symbols, abbreviations, and specifications.
Prerequisite: DFT 1104.

A-MEC 1113 Shop Processes 33

Study of practices used in metalworking shops: introduction of how materials can be utilized and to the processes of shaping, forming, and fabricating metals. Demonstration of the metalworking lathes, grinders, drills, milling machines, shapers, planers, saws, broachers, gear cutting machines, and finishing machines. A study of the capabilities of these machines.
Prerequisite: None.

A-MEC 1120 Duct Construction and Maintenance 44

Study of various duct materials including sheet steel, aluminum, and fiber glass. Safety, sheet metal hand tools, cutting and shaping machines, fasteners and fabrication practices, layout methods, and development of duct systems. The student will service various duct systems and perform on the site repairs including ducts made of fiber glass. A study is made of duct fittings, dampers and regulators, diffusers, heater and air washers, fans, insulation and ventilating hoods.
Prerequisite: DFT 1116, AHR 1123.
Co-requisite: AHR 1126.

A-MEC 1124 Metallurgy 33

Elementary and practical approach to metals, their structure, markings, classifications and uses. Interpretation of properties and specifications of steels by use of manuals, catalogs, charts, etc.
Prerequisite: None.

A-MEC 1105 Structural Fabrication 55

An introduction to the basic principles and an application of skills and knowledge to the general field of metal fabrication in the construction industries.
Prerequisite: None.

A-MEC 1141 Sheet Metal I 44

This course is designed to equip the sheet metal worker with the necessary technical knowledge to allow the trainee to become proficient in principles and practices of sheet metal layout and fabrication. The related mathematics, blueprint reading, sketching, drawing of layouts, and the using of the tools of the trade are correlated in planning and producing the basic projects. Surface development methods of prisms and other geometrical objects by the parallel line method are used to develop the projects. Spray painting of various production finishes is taught along with the different methods of corrosion prevention by using protective coatings.
Prerequisite: None.

A-MEC 1142 Sheet Metal II 44

A comprehensive knowledge of the principles of radial line development is obtained through this course. Drawings and fabrications of various fittings are made by using the round-pipe parallel-line development method, various conical objects using radial line method, and transition pieces using traingulation method. A brief written description of the procedure used in laying out and fabricating the fitting is necessary. Miscellaneous sheet metal fittings are developed and made in the shop. Weather caps, suction hood-ups, dust collectors, and various ventilation systems are examples of these principles. Applied mathematics is used in determining the areas, volumes of air and other problems.
Prerequisite: MEC 1141.

A-MEC 1145 Measurement and Layout 33

A basic course that covers measuring and layout tools common to the metal industries; principles of orthographic projection; parallel and radial methods of development and their application to layout work; and the measurement and layout of edges, seams, and notches. Step-by-step procedures for the development of patterns; for intersections of cylinders; rectangular and round tanks, etc.
Prerequisite: None.

A-WLD 1120 Oxayacetylene Welding and Cutting 44

Introduction to the history of oxyacetylene welding, the principles of welding and cutting, nomenclature of the equipment, assembly of units. Welding procedures such as practice of puddling and carrying the puddle, running flat beads, butt welding in the flat, vertical and overhead position, brazing, hard and soft soldering. Safety procedures are stressed throughout the program of instruction in the use of tools and equipment. Students perform mechanical testing and inspection to determine quality of the welds.
Prerequisite: None.

A-WLD 1121 Arc Welding 44

The operation of AC transformers and DC motor generator arc welding sets. Studies are made of welding heats, plarities, and electrodes for use in joining various metal alloys by the arc welding process. After the student is capable of running beads, butt and fillet welds in all positions are made and tested in order that the student may detect his weakness in welding. Safety procedures are emphasized throughout the course in the use of tools and equipment.
Prerequisite: None.

A-MEC 1143 Sheet Metal III 44

A study is made of working drawings, detailing, and layout for domestic and commercial installations; projects and fittings for exhaust, blowpipe, and refuse collecting systems; the application of sheet metal formulas are used in determing the area and volume of various fittings and projects.

A thorough understanding of the principles of triangulation, the method used to lay out patterns of irregular objects is developed. Skill in pattern development is acquired through the layout methods used for a variety of fittings and objects to be made in the shop, such as square-to-rounds, Y-branches, shoe tees, dust collectors, fume hoods and other transitions.
Prerequisite: MEC 1142.

SHEET METAL WORKER
OE-NCES 17.2305
OPTION--SHEET METAL LAYOUT DRAFTSMAN
OE-NCES 17.1300-2

Purpose of Program

This program guide with the option has been prepared to assist in planning and developing courses for workers in the sheet metal industry. Within the next five (5) years this industry will require at least 25,000 workers for replacements not counting the many needed for expansion.

This guide is organized to present the related materials that are needed for the trainee to be given a sound foundation in layout, a knowledge of fabrication and metals, and principles of basic product design. The trainee may choose to become a Sheet Metal Layout Draftsman by taking the sheet metal drafting courses as options. Also, he may continue his apprenticeship, or education in the area of his interest which may assist in leading to positions of responsibility.

The sheet metal workers and layout draftsmen are involved in an industry that is centered around construction and manufacturing. Workers install ducts which are used in ventilating, air conditioning, tobacco processing plants, and other systems requiring movement of air. They also fabricate and install roofing, siding, flashing, venting, commercial stainless steel kitchen equipment, cabinets, partitions, store fronts, metal framework for advertising signs, and structures used for material movement and collection.

Career Opportunities

The beginning sheet metal workers are required to be skilled in all aspects to use tools and machines of cutting, forming, bolting, riveting, cementing, punching, pressing, drilling, sawing, welding, brazing, and soldering the products. Generally, the experienced sheet metal worker, foreman or leader, plans and lays out the job and takes the responsibility to determine the size and type of metal to be used.

The beginning worker will assist in the installation of the products including several types of plastics used for air or liquid. Many experienced sheet metal workers become expert layout draftsmen and planners in the industry.

METAL WORKING OCCUPATIONS

SHEET METAL WORKER
(Sheet Metal Layout Drafting-Option)
OE-NCES 17.2305
OE-NCES 17.1300-2

REQUIRED BASIC COURSES

No.	Title	Hours
ENG 1101	Reading Improvement	22
ENG 1102	Communication Skills	33
ISC 1001	Industrial Safety	33
PSY 1101	Human Relations	33
BUS 1103	Small Business Operations	33
MAT 1101	Fundamentals of Mathematics	55
MAT 1103	Geometry	33
PHY 1101	Applied Science	55
PHY 1102	Applied Science	55
A-MEC 1115	Treatment of Ferrous Metals	33
A-DFT 1121	Drafting (Elementary Projection)	66
A-DFT 1116	Blueprint Reading - Air Conditioning	44

REQUIRED RELATED COURSES

A-MEC 1141	Sheet Metal I	44
A-MEC 1142	Sheet Metal II	44
A-MEC 1143	Sheet Metal III	44
A-MEC 1144	Sheet Metal IV	44
A-MEC 1145	Measurement and Layout	44

ELECTIVE COURSES (Sheet Metal Layout Drafting-Option)

A-DFT 1151	Sheet Metal Layout Drafting I	44
A-DFT 1152	Sheet Metal Layout Drafting II	44
A-DFT 1153	Sheet Metal Layout Drafting III	44
A-DFT 1154	Sheet Metal Layout Drafting IV	44
MAT 1104	Trigonometry	33
DFT 1125	Descriptive Geometry	33

OTHER ELECTIVE COURSES

A-DFT 1107	Blueprint Reading (Structural)	33
A-DFT 1122	Drafting	66
DFT 1104	Blueprint Reading	33
A-AHR 1123	Principles of Air Conditioning	33
A-AHR 1124	Air Conditioning & Refrigeration Service	33
A-MEC 1116	Treatment of Non-Ferrous Metals	33
MAT 1102	Algebra	55
WLD 1103	Welding	33
WLD 1104	Basic Welding and Cutting (a. Theory	22
	b. Lab	33

SHEET METAL WORKER
(Sheet Metal Layout Drafting-Option)
OE-NCES 17.2305
OE-NCES 17.1300-2

COURSE DESCRIPTIONS

No.	Title	Hours
A-MEC 1115	Treatment of Ferrous Metals	33

Investigates the properties of ferrous metals and tests to determine their uses. Instructions will include some chemical metallurgy to provide a background for the understanding of the physical changes and causes of these changes in metals. Physical metallurgy of ferrous metals, producing iron and steel, theory of alloys, shaping and forming, heat treatments for steel, surface treatments, alloy of special steel, classification of steels, and cast iron will be topics for study.
Prerequisite: None.

A-DFT 1121	Elementary Drafting	66

An introduction to drafting and the study of drafting practices. Instruction is given in the selection, use and care of instruments, single-stroke lettering, applied geometry, freehand sketching consisting of orthographic and pictorial drawings. Orthographic projection, reading and instrument drawing of principal views, single auxiliary views (primary), and double (oblique) auxiliary views will be emphasized. Dimensioning and note practices will be studied with reference to the American Standards Association practices. Methods of reproducing drawings will be included at the appropriate time.
Prerequisite: None.

A-DFT 1116	Blueprint Reading - Air Conditioning	44

A specialized course in drafting for the heating, air conditioning and refrigeration student. Emphasis will be placed on reading of blueprints that are common to the trade; blueprints of mechanical components, assembly drawings, wiring diagrams and schematics, floor plans, heating system plans, including duct and equipment layout plans, and shop sketches. The student will make tracings of floor plans and layout air conditioning systems.
Prerequisite: DFT 1122.

A-MEC 1141 Sheet Metal I 44

Instruction is arranged to allow the trainee to become proficient in principles and practices of sheet metal layout and fabrication. The related mathematics blueprint reading, sketching, drawing of layouts, and the using of the tools of the trade are correlated in planning and producing the on-the-job projects. The related information is arranged in a logical sequence designed to promote the rapid advancement of the apprentice on the job. Spray painting of various production finishes is taught along with the different methods of corrosion prevention by protective coatings.
Prerequisite: None.

A-MEC 1142 Sheet Metal II 44

In solving the various problems assigned, the trainee should progress at his own with a minimum amount of supervision. Drawings and fabrication of fittings of round pipe using parallel line development through various transition pieces using triangulation method. A brief written description of the procedure used in laying out and fabricating the fitting is necessary. General questions must be answered that apply to the students work in the sheet metal trade.
Prerequisite: A-MEC 1141.

A-MEC 1143 Sheet Metal III 44

A study is made of working drawings, detailing, and layout for domestic and commercial installations; projects and fittings for exhaust, blowpipe, and refuse collecting systems; the application of sheet metal formulate in determining the area and volume of various fittings and projects. General questions must be discussed that apply to the on-the-job work of the apprentice.
Prerequisite: A-MEC 1142.

A-MEC 1144 Sheet Metal IV 44

An advanced study is made by developing working drawings and layout patterns for intricate articles, fittings, and projects in all branches of sheet metal work. Projects such as, rectangular-to-round double offset, psychrometric processes and charts, elbow boats, estimating the air conditioning, cooling and heating loads. A brief description of the procedure used in laying out or estimating the problems is required. Individual help is given each trainee in laying out such problems as three-piece rectangular-to-round elbow.
Prerequisite: A-MEC 1143.

A-MEC 1145 Measurement and Layout 44

A basic course that covers measuring and layout tools common to the metal industries; principles of orthographic projection; parallel and radial methods of development and their application to layout work; and the measurement and layout of edges, seams, and notches. Step-by-step procedures for the development of patterns, for intersections of cylinders, and construction of retangular and round tanks, are included
Prerequisite: None.

A-DFT 1151 Sheet Metal Layout Drafting I 44

This course is designed to equip the sheet metal worker with the necessary technical knowledge in Layout Drafting to supplement actual experience gained on the job. The fundamentals of pattern development and layout of air conditioning and ventilating problems and sheet metal construction are presented. Surface development methods of prisms and other geometrical objects by the parallel line method are practiced.
Prerequisite: A-MEC 1141 or equivalent.

A-DFT 1152 Sheet Metal Layout Drafting II 44

A comprehensive knowledge of the principles of radial line development may be obtained through this course. Patterns of various conical objects are developed in which these principles are applied. Many intersections of cylinders and cones, cones and prisms, and cones and cones are solved through layout drafting. Miscellaneous sheet metal fittings are developed through these methods. Weather caps, suction hook-ups, dust collectors and various ventilation systems are examples of these principles.
Prerequisite: A-DFT 1151 and A-MEC 1141.

A-DFT 1153 Sheet Metal Layout Drafting III 44

This course developes a thorough understanding of the principles of triangulation, the method used to lay out patterns of irregular objects. Skill in pattern development is acquired through the development of patterns for a variety of fittings and objects, such as square-to-rounds, Y-branches, shoe tees, dust collectors, fume hoods and other transistions.
Prerequisite: A-DFT 1152 and A-MEC 1142 or equivalent.

A-DFT 1154 Sheet Metal Layout Drafting IV 44

This is a course in which all methods of pattern development are used and short cuts developed. Complex fittings are designed and their patterns developed. Upon satisfactory completion of this course the apprentice or student should be able to cope with any layout problem. All types of duct systems, welded pipe systems, industrial guards for fans and machinery, roof ventilators for industrial plants, tanks, measuring cans and various other transition fittings. Skills in the saving of time, materials and effort are stressed when these layouts are made.
Prerequisite: A-DFT 1153 and A-MEC 1143 or equivalent.
Corequisite: A-MEC 1144 or equivalent.

DFT 1125 Descriptive Geometry 33

Graphical analysis of space problems. The problems deal with practical design elements involving points, lines, planes, connectors, and a combination of these. Included are problems dealing with solid geometry theorems. Where applicable, each graphical solution shall be accompanied by the analytical solution.
Prerequisite: A-DFT 1152.

OTHER ELECTIVE COURSES

A-DFT 1107 Blueprint Reading (Structural) 33

The student is trained to read structural steel detail drawings. These prints are consistent with accepted trade practices, structural fabrication, and erection procedures. Course includes the study of symbols, structural shapes, methods of connection; plate and tank development, and an introduction to beam and column loading.
Prerequisite: A-DFT 1104.

A-DFT 1122 Drafting 66

A course in practical mechanical drafting applied to the trades. The trainee will study simple and successive revolutions and their applications to practical problems. Sections and conventions will be studied and both detail and assembly sections will be drawn. Intersections and developments will be studied by relating the drawing to the sheet metal trades. Models of the assigned drawings will be made from construction paper, cardboard, or similar materials as a proof of the solution to the problems drawn. Special consideration of dimensioning tolerances, finishes and standard notations on drawings of casting, forgings and machine parts.
Prerequisite: A-DFT 1121.

DFT 1104 Blueprint Reading 33

Interpretation and reading of blueprints. Information on the basic principles of the blueprint; lines, views, dimensioning procedures and notes.
Prerequisite: None.

A-AHR 1123 Principles of Air Conditioning 33

Work includes the selection of various heating, cooling and ventilating systems, investigation and control of factors affecting air cleaning, movement, temperature, and humidity. Use is made of psychrometric charts in determing needs to produce optimum temperature and humidity control. Commercial air conditioning equipment is assembled and tested. Practical sizing and balancing of ductwork is performed as needed.
Prerequisite: A-AHR 1122.

A-AHR 1124 Air Conditioning & Refrigeration Service 33

Emphasis is placed on the installation, maintenance, and servicing of equipment used in the cleaning, changing, humidification and temperature control of air in an air conditioned space. Installation of various ducts and lines needed to connect various components is made. Shop work involves burner operation, controls, testing and adjusting of air conditioning and refrigeration equipment, and location and correction of equipment failure.
Prerequisite: A-AHR 1123.

A-MEC 1116 Treatment of Non-Ferrous Metals 33

Continuation of the study of physical metallurgy. The non-ferrous metals: bearing metals, (brass, bronze, lead), light metals (aluminum and magnesium), and copper and its alloys are studied. Powder metallurgy, titanium, zirconium, indium, vanadium, and also plastics are included in this course. Prerequisite: A-MEC 1115.

WLD 1103 Welding 33

The various processes used for joining materials by welding are discussed. Lecture, demonstrations and practice covered the oxyacetylene and art welding processes, filler metals used, gases, currents, weldability of metals. Instruction is given in the set-up and safe operation of oxyacetylene welding apparatus. Students prepared joints by both hand and machine cutting with the oxyacetylene torch.

WLD 1104 Basic Welding and Cutting 33

Welding demonstrations by the instructor and practice by students in the welding shop. Safe and correct methods of assembling and operating the welding equipment. Practice will be given for surface welding; bronze welding, silver soldering, arc and gas-arc welding methods applicable to mechanical repair work.
Prerequisite: None.

WELDING
OE-NCES 17.2306

INTRODUCTION

Purpose of Program

This curriculum was developed to fill the tremendous need for welders in North Carolina. The recently completed Manpower Survey shows quite clearly that many welders will be needed annually to fill present and projected vacancies in the state for the next ten years.

The content of this program is designed to give students sound understanding of the principles, methods, techniques and skills essential for successful employment in the welding field and metals industry.

The field of welding offers a person prestige, security and a future of continuous employment with steady advancement. It offers employment in practically any industry: shipbuilding, automotive, aircraft, guided missiles, atomic energy installations, railroads, construction, pipe fitting, tank building, production shops, job shops, and many others.

Career Opportunities

Welders join metals by applying intense heat, and sometimes pressure, to melt the edges to form a permanent bond. Closely related to welding is "oxygen cutting." Of the more than 35 different ways of welding metals, arc, gas, resistance, modern "MIG" & "TIG" welding are the most important. Recent developments in "MIG" & "TIG" welding of aluminum alloys and other thin sheets makes a greater demand for welders.

The principal duty of the welder using manual techniques is to control the melting by directing the heat from either an electric arc or gas welding torch, and to add filler metal where necessary to complete the joint. He/she should possess a great deal of manipulative skill with a knowledge of jigs, welding symbols, mathematics, basic metallurgy, and blueprint reading. The use of automatic and semi-automatic welding equipment in production plants requires more skilled technicians and maintenance workers.

WELDING
OE-NCES 17.2306

REQUIRED BASIC COURSES

No.	Title	Hours
ENG 1101	Reading Improvement	22
ENG 1102	Communications Skills	33
MAT 1101	Fundamentals of Mathematics	55
ISC 1101	Industrial Safety	33
PSY 1101	Human Relations	33
BUS 1101	Small Business Operations	55

REQUIRED RELATED COURSES

A-WLD 1106	Intermediate Welding	33
A-WLD 1107	Advanced Welding	33
A-WLD 1108	Welding Processes	33
A-WLD 1112	Mechanical Testing & Inspection	33
A-WLD 1120	Oxyacetylene Welding & Cutting	33
A-WLD 1121	Arc Welding	33
DFT 1104	Blueprint Reading	33
DFT 1117	Blueprint Reading: Welding	33
A-MEC 1115	Treatment of Ferrous Metals	33
A-MEC 1116	Treatment of Non-ferrous Metals	33
PHY 1101	Applied Science	55

ELECTIVE COURSES

DFT 1118	Pattern Development & Sketching	33
A-WLD 1122	Commercial and Industrial Practices	33
A-WLD 1123	Inert Gas Welding	22
A-WLD 1124	Pipe Welding	33
MAT 1103	Geometry	33
BUS 1105	Industrial Organizations	33

NOTE: On-the-job training takes the place of laboratory work except for demonstrations.

WELDING
OE-NCES 17.2306

COURSE DESCRIPTION

No.	Title	Hours
A-WLD 1106	Intermediate Welding	33

This is a combined welding course which gives the student experience in all types of welding. Fundamentals of inert gas welding is introduced using both argon and carbon dioxide for the shielded arc. Fabrication of metal structures, position welding, safety and care of equipment are stressed.
Prerequisites: A-WLD 1120, A-WLD 1121.

A-WLD 1107	Advanced Welding	33

This is a combined course in all types of welding and cutting. It is designed to produce a more experienced welder with increased speed. The instruction includes non-ferrous alloys, alloy castings, tool steels and the more intricate welding procedures and applications.
Prerequisites: A-WLD 1106, A-WLD 1120, and A-WLD 1121.

A-WLD 1108	Welding Processes	44

A review in the principles and theory of various welding processes such as metallic arc welding, gas welding, arc and gas cutting, atomic hydrogen welding, thermit welding, carbon arc welding, inert-gas shielded arc welding, and hard-facing. Two relatively new welding processes are discussed: ultrasonic welding of foil and gage wire, and vacuum electron beam welding. Special consideration is given to difficult problems encountered in welding certain joints made of special metals.
Prerequisites: A-WLD 1106 and A-WLD 1107.

A-WLD 1112	Mechanical Testing and Inspection	33

The standard methods for mechanical testing of welds. The student is introduced to the various types of tests and testing procedures and performs the details of the test which will give adequate information as to the quality of the weld. Types of tests to be covered are bend, destructive, free-bend, guided-bend, nick-tear, notched-bend, tee-bend, non-destructive, V-notch, Charpy impact, etc.
Prerequisites: A-WLD 1120, A-WLD 1121.

A-WLD 1120 Oxacetylene Welding and Cutting 33

Introduction to the history of oxyacetylene welding, the principles of welding and cutting, nomenclature of the equipment, assembly of units. Welding procedures such as practice of puddling and carrying the puddle, running flat beads, butt welding in the flat, vertical and overhead position, brazing, hard and soft soldering. Safety procedures are stressed throughout the program of instruction in the use of tools and equipment. Students perform mechanical testing and inspection to determine quality of the welds.
Prerequisite: None.

A-WLD 1121 Arc Welding 33

The operation of AC transformers and DC motor generator arc welding sets. Studies are made of welding heats, polarities, and electrodes for use in joining various metal alloys by the arc welding process. After the student is capable of running beads, butt and fillet welds in all positions are made and tested in order that the student may detect his weaknesses in welding. Safety procedures are emphasized throughout the course in the use of tools and equipment.
Prerequisite: None.

DFT 1104 Blueprint Reading 33

Interpretation and reading of blueprints. Information on the basic principles of the blueprint; lines, views, dimensioning procedures and notes.
Prerequisite: None.

DFT 1117 Blueprint Reading: Welding 33

A thorough study of trade drawings in which welding procedures are indicated. Interpretation, use and application of welding symbols, abbreviations, and specifications.
Prerequisite: DFT 1104.

A-MEC 1115 Treatment of Ferrous Metals 33

Investigates the properties of ferrous metals and tests to determine their uses. Instructions will include some chemical metallurgy to provide a background for the understanding of the physical changes and causes of these changes in metals. Physical metallurgy of ferrous metals, producing iron and steel, theory of alloys, shaping and forming, heat treatments for steel, surface treatments, alloy of special steel, classification of steels, and cast iron will be topics for study.
Prerequisite: None.

A-MEC 1116 Treatment of Non-ferrous Metals 33

Continuation of the study of physical metallurgy. The non-ferrous metals: bearing metals, (brass, bronze, lead), light metals (aluminum and magnesium), and copper and its alloys are studied. Power metallurgy, titanium, zirconium, indium, vanadium, and also plastics are included in this course.
Prerequisite: A-MEC 1115.

DFT 1118 Pattern Development and Sketching 33

Continued study of welding symbols; methods used in layout of sheet steel; sketching of projects, jigs and holding devices involved in welding. Special emphasis is placed on developing pipe and angle layouts by the use of patterns and templates.
Prerequisite: None.

A-WLD 1122 Commercial and Industrial Practices 33

Designed to build skills through practices in simulated industrial processes and techniques: sketching and laying out on paper the size and shape description, listing the procedure steps necessary to build the product. Emphasis is placed on maintenance, repairing worn or broken parts by special welding applications, field welding and nondestructive tests and inspection.
Prerequisites: A-WLD 1120 and A-WLD 1121.

A-WLD 1123 Inert Gas Welding 22

Introduction and practical operations in the use of inert-gas-shield arc welding. A study will be made of the equipment, operation, safety and practice in the various positions. A thorough study of such topics as principles of operation, shielding gases, filler rods, process variations and applications, manual and automatic welding.
Prerequisite: A-WLD 1121.

MECHANICAL DRAFTSMAN
OE-NCES 17.1300-1

INTRODUCTION

Purpose of Program

This program is designed to prepare students to enter the field of mechanical drafting. The first two courses in drawing are basic to all fields of drafting. The third and fourth courses contain specialization and related courses that prepare one to enter mechanical drafting occupations.

Each course is prepared to enable an individual to advance rapidly in drafting proficiency upon entering the field of work. Courses are arranged in sequence tc develop drafting skills and proficiency in mathematics and science. The draftsman associates with many levels of personnel--administrative, engineers, technicians, skilled workmen--and must be able to communicate effectively with them. Courses to develop knowledge and skills in communication, human relations, safety, and industrial organization are provided to assist the student in developing understandings and confidence in his/her relations with other persons.

Career Opportunities

Draftsman prepares clear, complete, and accurate working plans and detail drawings, from rough or detailed sketches or notes for engineering or manufacturing purposes, according to the specified dimensions: makes final sketch of the proposed drawing, checking dimension of parts, materials to be used, the relation of one part to another, and the relation of the various parts to the whole structure. Makes any adjustments or changes necessary or desired. Exercises manual skill in the manipulation of triangle, T-square, and other drafting tools. He learns to letter proficiently on the drawings, makes charts for representation of statistical data, and finished designs from sketches. Utilizes knowledge of various machines, engineering practices, mathematics, building materials, and other physical sciences to complete the drawings.

Mechanical draftsman performs the general duties of a draftsman and also he specializes in making rough drafting sketches of proposed mechanical devices, and then drawing necessary details. Prepares accurate scale drawings of parts or machines from specifications.

MECHANICAL DRAFTSMAN
OE-NCES 17.1300-1

REQUIRED BASIC COURSES

No.	Title	Hours
ENG 1101	Reading Improvement	22
ENG 1102	Communication Skills	33
ISC 1001	Industrial Safety	33
PSY 1101	Human Relations	33
BUS 1105	Industrial Organizations	33
MAT 1102	Algebra	55
MAT 1103	Geometry	33
MAT 1104	Trigonometry	33

REQUIRED RELATED COURSES

DFT 1104	Blueprint Reading	33
A-DFT 1121	Drafting	66
A-DFT 1122	Drafting	66
A-DFT 1125	Descriptive Geometry	33
A-DFT 1131	Mechanical Drafting	66
A-DFT 1132	Mechanical Drafting	66

ELECTIVE COURSES

ENG 1103	Report Writing	33
BUS 1103	Small Business Operations	33
A-MEC 1113*	Shop Processes	55
	a. Theory	22
	b. Shop *	33
A-MEC 1114*	Shop Processes	55
	a. Theory	22
	b. Shop*	33
A-MEC 1115	Treatment of Ferrous Metals	33
A-MEC 1116	Treatment of Non-Ferrous Metals	33

* On-the-job training can be substituted for lab.

INDUSTRIAL OCCUPATIONS

MECHANICAL DRAFTSMAN
OE-NCES 17.1300-T

COURSE DESCRIPTIONS

No.	Title	Hours
DFT 1104	Blueprint Reading	33

Interpretation and reading of blueprints. Information on the basic principles of the blueprint; lines, views, dimensioning procedures and notes.
Prerequisite: None.

A-DFT 1121	Drafting	66

An introduction to drafting and the study of drafting practices. Instruction is given in the selection, use and care of instruments, single-stroke lettering, applied geometry, freehand sketching consisting of orthographic and pictorial drawings. Orthographic projection, reading and instrument drawing of principal views, single auxiliary views (primary), and double (oblique) auxiliary views will be emphasized. Dimensioning and note practices will be studied with reference to the American Standards Association practices. Methods of reproducing drawings will be included at the appropriate time.
Prerequisite: None.

A-DFT 1122	Drafting	66

A course in practical mechanical drafting applied to the trades. The trainee will study simple and successive revolutions and their applications to practical problems. Sections and conventions will be studied and both detail and assembly sections will be drawn. Intersections and developments will be studied by relating the drawing to the sheet metal trades. Models of the assigned drawings will be made from construction paper, cardboard, or similar materials as a proof of the solution to the problems drawn. Special consideration of dimensioning tolerances, finishes and standard notations on drawings of castings, forgings and machine parts.
Prerequisite: A-DFT 1121.

A-DFT 1125	Descriptive Geometry	33

Graphical analysis of space problems. The problems deal with practical design elements involving points, lines, planes, connectors, and a combination of these. Included are problems dealing with solid geometry theorems. Where applicable, each graphical solution shall be accompanied by the analytical solution.
Prerequisite: A-DFT 1121.

A-DFT 1131 Drafting: Mechanical 66

An introduction to mechanical drafting beginning with problems concerning precision and limit dimensioning. Methods of fastening materials, and fasteners: keys, rivets, springs, and welding. Symbols will be studied and drawings will be made involving these items. Principles of design will be introduced with the study of basic mechanisms of motion transfer; gears, cams, power trains, pulleys, belting and methods of specifying and calculating dimensions will be studied. Drawings will be made involving these mechanisms.
Prerequisite: A-DFT 1122.

A-DFT 1132 Drafting: Mechanical 66

Principles of design sketching, design drawings, layout drafting, detailing from layout drawings, production drawings and simplified drafting practices constitute areas of study. Forging and casting drawings will be made from layouts. Specifications, parts list and bill of materials are emphasized in this course. The student will develop a complete set of working drawings of a tool, jig, fixture or simple machine and learn principles of design, handbook and manual usage.
Prerequisite: A-DFT 1131.

A-MEC 1113* Shop Processes 55

Study of practices used in metalworking shops: introduction to how materials can be utilized, and to the processes of shaping, forming and fabricating of metals. Demonstration of the metalworking lathes, grinders, drills, milling machines, shapers, planers, saws, broachers, gear cutting machines and finishing machines. A study of the capabilities of these machines.
Prerequisite: None.

A-MEC 1114* Shop Processes 55

Comparison of the unit-production and mass-production systems. Casting, forging and allied processes, welding and sheet metal working processes are demonstrated and discussed. Mass-production methods are studied in relationship to precision dimensional control.
Prerequisite: A-MEC 1113.

A-MEC 1115 Treatment of Ferrous Metals 33

Investigates the properties of ferrous metals and tests to determine their uses. Instructions will include some chemical metallurgy to provide a background for the understanding of the physical changes and causes of these changes in metals. Physical metallurgy of ferrous metals, producing iron and steel, theory of alloys, shaping and forming, heat treatments for steel, surface treatments, alloy of special steel, classification of steels, and cast iron will be topics for study.
Prerequisite: None.

* On-the-job training can be substituted for lab.

A-MEC 1116 Treatment of Non-Ferrous Metals

Continuation of the study of physical metallurgy. The non-ferrous metals: bearing metals, (brass, bronze, lead), light metals (aluminum and magnesium), and copper and its alloys are studied. Power metallurgy, titanium, zirconium, indium, vanadium, and also plastics are included in this course. Prerequisite: A-MEC 1115.

AUTO BODY REPAIRMAN
OE-NCES 17.0301

INTRODUCTION

Purpose of Program

The field of automotive body repair and painting needs many more well-trained people to meet the growing demand for the many special skills in this area of employment. In this program, much of the students' time in the shop is devoted to learning skills and practicing these skills on car bodied and their component parts. Every apprentice is given these practical experiences by working on actual on-the-job situations. The practical experience and related instruction provide an ideal way to prepare the students for entry into an occupation that offers many job opportunities.

This type of instruction includes reading and interpreting blueprints, charts instruction and service manuals, and wiring diagrams. The apprentice learns to prepare orders for repairs and parts, as well as estimates and statements for adjusters.

Career Opportunities

Graduates of the Auto Body Repair Program are qualified for jobs in which they remove dents in automobile bodies and fenders; take off fenders and replace them with new ones; straighten frames, doors, hoods, and deck lids; and align wheels. In their work, these craftsmen operate modern welding and brazing equipment, and also, make tests on and repair engine cooling systems. Auto body repairmen shrink stretched metal and prepare it for painting. They are called on to paint fenders and/or panels as well as to paint a complete vehicle.

In addition to the above duties, auto body repairmen remove, cut, fit, and install glass. They are required to remove and install interior trim; cut, sew, and install headings and seat covers; repair and replace upholstery and fabric tops of vehicles; and rebuild springs and padding. After gaining experience, many of these craftsmen open their own businesses or become body shop foremen, supervisors, or managers.

MECHANICS AND REPAIRMAN

AUTO BODY REPAIRMAN
OE-NCES 17.0301

REQUIRED BASIC COURSES

No.	Title	Hours
ENG 1101	Reading Improvement	22
ENG 1102	Communication Skills	33
MAT 1101	Fundamentals of Mathematics	55
PSY 1101	Human Relations	33
ISC 1001	Industrial Safety	33
BUS 1103	Small Business Operations	33
PHY 1101	Applied Science	55
PHY 1102	Applied Science	55
WLD 1101	Basic Gas Welding	33
WLD 1105	Auto Body Welding	33

REQUIRED RELATED COURSES

A-AUT 1111	Auto Body Repair	33
A-AUT 1112	Auto Body Repair	33
A-AUT 1113	Metal Finishing and Painting	33
A-AUT 1114	Body Shop Applications	33
A-AUT 1115	Trim, Glass and Radiator Repair	22

ELECTIVE COURSES

A-AUT 1116	Auto Body Repair: Estimating	33
A-AUT 1117	Major Auto Body Repair	33
A-AUT 1118	Auto Body Shop Operations	22
A-AUT 1123	Brakes, Chassis and Suspension Systems	33

AUTO BODY REPAIR
OE-NCES 17.0301

COURSE DESCRIPTIONS

No.	Title	Hours
A-AUT 1111	Auto Body Repair	33

Basic principles of automobile construction, design, and manufacturing. A thorough study of angles, crown, and forming of steel into the complex contour of the present day vehicles. The student applies the basic principles of straightening, aligning, and painting of damaged areas.
Prerequisite: None.

A-AUT 1112	Auto Body Repair	33

A thorough study of the requirements for a metal worker, including the use of essential tools, forming fender flanges and beads, and straightening typical auto body damage. The student begins acquiring skills such as shaping angles, crowns, and contour of the metal of the body and fenders. Metal working and painting.
Prerequisites: A-AUT 1111, WLD 1101, PHY 1101, MAT 1101.

A-AUT 1113	Metal Finishing and Painting	33

Development of the skill to shrink stretched metal, soldering and leading, and preparation of the metal for painting. Straightening of doors, hoods, and deck lids; fitting and aligning. Painting fenders and panels, spot repairs, and complete vehicle painting; the use and application of power tools.
Prerequisites: A-AUT 1112, WLD 1105.

A-AUT 1114	Body Shop Applications	33

General introduction and instruction in the automotive frame and front end suspension systems, the methods of operation and control, and the safety of the vehicle. Unit job application covers straightening of frames and front wheel alignment. The student applies all phases of training. Repair order writing, parts purchasing, estimates of damage, and developing the final settlement with the adjuster.
Prerequisites: A-AUT 1115, PHY 1102, DFT 1101.

A-AUT 1115 Trim, Glass and Radiator Repair 22

Methods of removing and installing interior trim; cutting, sewing and installing headlinings, seat covers, and door trim panels; painting of trim parts and accessories. Glass removal, cutting, fitting, and installation. The student gains a thorough knowledge of the engine cooling system and repairs and replaces damaged cooling system components. Tests are made to insure normal engine cooling operation.
Prerequisites: A-AUT 1112, WLD 1105.

A-AUT 1116 Auto Body Repair: Estimating 33

General estimating is stressed with regard to securing business from the insurance company and the car owner. Glass work is estimated as well as all phases of body work. Work is estimated on a time basis and actual wrecked cars are used. Instruction is given in the use of handbooks, interpreting specifications, and applying such information to the job.
Prerequisites: All Basic Auto Body Courses or Equivalent Experience.

A-AUT 1117 Major Auto Body Repair Planning 33

In this course the student does major planning for repair work which consists of restoring a complete wreck to the original contour and finish including frame, front end, and all alignment procedures and glass work. Estimate and procedure sheets are required along with a written report if necessary.
Prerequisites: All Basic Auto Body Courses or Equivalent Experience.

A-AUT 1118 Auto Body Shop Operations 22

Setting up, equipping, and operating a body shop are covered in this course. An adequate list of equipment, placing of major equipment and the spray booth operations are considered. A procedure of how to process a typical job is written.
Prerequisite: All Major Auto Body Courses or Equivalent Experience.

A-AUT 1123 Brakes, Chassis, and Suspension Systems 33

A complete study of various braking systems employed on automobiles and light weight trucks. Emphasis is placed on how they operate, proper adjustment and repair. Also, the servicing of parking brakes is emphasized. Principles and functions of the components of automotive chassis. Practical job instruction in adjusting and repairing of suspension systems.
Prerequisite: None.

WLD 1101 Basic Gas Welding 33

Welding demonstrations by the instructor and practice by students in the welding shop. Safe and correct methods of assembling and operating the welding equipment. Practice will be given for surface welding; bronze welding, silver soldering, and flame-cutting methods applicable to mechanical repair work.
Prerequisite: None.

WLD 1105 Auto Body Welding 33

Welding practices on material applicable to the installation of body panels and repairs to doors, fenders, hoods, and deck lids. Student runs beads, does butt and fillet welding. Performs tests to detect strength and weaknesses of welded joints. Safety procedures are emphasized throughout the course.
Prerequisite: WLD 1101.

AUTOMOTIVE MECHANICS
OE-NCES 17.0302

INTRODUCTION

Purpose of Program

This guide outlines a training program for developing the basic knowledge and skills needed to inspect, diagnose, repair or adjust automotive vehicles. Manual skills are developed in practical shop work. Thorough understanding of the operating principles involved in the modern automobile comes in class assignments, discussion, and shop practice.

Complexity in automotive vehicles increases each year because of scientific discovery and new engineering. These changes are reflected not only in passenger vehicles, but also in trucks, buses and a variety of gasoline-powered equipment. This program provides a basis for the student to compare and adapt to new techniques for servicing and repair as vehicles are changed year by year.

Career Opportunities

Automobile mechanics maintain and repair mechanical, electrical, and the chassis of passenger cars, trucks, and buses. In some communities and rural areas they also may service tractors or marine engines and other gasoline-powered equipment. Mechanics inspect and test to determine the causes of faulty operation. They repair or replace defective parts to restore the vehicle or machine to proper operating condition. They use shop manuals and other technical publications; such as, Motor's Auto Repair Manual and New Auto Repair Manual by Chilton for data and specifications.

Automotive mechanics in smaller shops usually are general mechanics qualified to perform a variety of repair jobs. A large number of automobile mechanics specialize in particular types of repair work. For example, some may specialize in repairing only power steering and power brakes, or automatic transmissions. Usually such specialists have an all-round knowledge of automotive repair and may occasionally be called upon to do other types of work.

MECHANICS AND REPAIRMAN

AUTOMOTIVE MECHANICS
OE-NCES 17.0302

REQUIRED BASIC COURSES

No.	Title	Hours
ENG 1101	Reading Improvement	22
ENG 1102	Communication Skills	33
MAT 1101	Fundamentals of Mathematics	55
PSY 1101	Human Relations	33
ISC 1001	Industrial Safety	33
BUS 1103	Small Business Operations	33
PHY 1101	Applied Science	55
PHY 1102	Applied Science	55
WLD 1104	Basic Welding and Cutting	33
DFT 1101	Schematics and Diagrams: Power Mechanics	33

REQUIRED RELATED COURSES

A-AUT 1101	Introduction to Automobile Mechanics	33
A-AUT 1102	Internal Combustion Engines I	33
A-AUT 1103	Internal Combustion Engines II	33
A-AUT 1104	Ignition and Fuel Systems I	55
A-AUT 1105	Ignition and Fuel Systems II	55
A-AUT 1106	Automotive Electrical Circuits	44
A-AUT 1107	Automatic Transmissions I	44
A-AUT 1108	Automotive Shop Service	22
A-AUT 1109	Service Management (Auto)	33
A-AUT 1121	Braking Systems I	33
A-AUT 1122	Suspensions and Braking Systems II	33
A-AUT 1123	Brakes, Chassis and Suspension Systems	33
A-AUT 1124	Automotive Power Train Systems	33
A-AUT 1125	Automotive Diagnosis and Servicing	33
A-AHR 1101	Automotive Air Conditioning	22

ELECTIVE COURSES

A-AUT 1110	Automotive Machine Shop	66
A-AUT 1127	Automatic Transmissions II	22
A-AUT 1128	Automatic Transmissions III	22
DFT 1104	Blueprint Reading	33
DFT 1105	Blueprint Reading: Mechanical	33
MEC 1112	Machine Shop Processes	66
A-MEC 1115	Treatment of Ferrous Metals	33
A-MEC 1116	Treatment of Non-Ferrous Metals	33

AUTOMOTIVE MECHANICS
OE-NCES 17.0302

COURSE DESCRIPTIONS

No. Title Hours

A-AUT 1101 Automotive Mechanics I 33

This is a general survey course for automobile apprentices to be studied in conjunction with schematics and diagrams. Instruction is given in the history of the trade and the meaning of apprenticeship; care and use of tools and power equipment; safety; study of general maintenance work starting with the engine and including the chassis, frame, steering front end; brakes; shock absorbers; lubricants and other materials used. Co-Requisite: DFT 1101 Schematics and Diagrams.

A-AUT 1102 Internal Combustion Engines I 33

Development of a thorough knowledge and ability in using, maintaining, and storing the various hand tools and measuring devices needed in engine repair work. Study of the construction and operation of components of internal combustion engines. Testing of engine performance; servicing and maintenance of pistons, valves, cams and camshafts, fuel and exhaust systems, cooling systems; proper lubrication; and methods of testing, diagnosing and repairing.
Prerequisite: None.

A-AUT 1103 Internal Combustion Engines II 33

This course is designed to further acquaint the student with the design, operation, trouble-shooting and service procedures of the modern gasoline engines. Adequate service and technical engine data are presented to assist the students with their on-the-job experiences in engine servicing.
Prerequisites: DFT 1101 and A-AUT 1101.

A-AUT 1104 Ignition and Fuel Systems I 55

A thorough study of the ignition and fuel systems of the automobile. Battery cranking mechanism, generator, ignition, accessories and wiring; fuel pumps, carburetors, and fuel injectors. Characteristics of fuels, types of fuel systems, special tools, and testing equipment for the fuel and ignition system.
Prerequisite: A-AUT 1102.

A-AUT 1105 Ignition and Fuel Systems II 55

This course included instruction on modern A.C. and D. C. generators and control units, carburetion, and transistor controlled systems. The construction function, operation, trouble-shooting procedures are studied and servicing and testing requirements are stressed. Laboratory demonstrations of disassembly and reassembly of components, performance of required bench tests should be made with the students participating when possible.
Prerequisite: A-AUT 1102.

A-AUT 1106 Automotive Electrical Circuits 44

Through lecture, demonstration, and laboratory experience the horn circuit, windshield wiper circuit, instrument circuit, lighting circuit, and electric power accessory circuits are studied. Time also is devoted to the understanding and use of vehicle wiring diagrams. The students have an opportunity to participate in disassembly and reassembly of components and the bench testing needed to determine serviceability.
Prerequisite: A-AUT 1105.

A-AUT 1108 Automotive Shop Service 22

New vehicle service routine, installation of accessories, body service and inspection. Shop routine for diagnosis and repair of used vehicles. Students are expected to develop work standards in quality and quantity of work produced.
Prerequisite: All Required Related Courses.

A-AUT 1109 Service Management (Auto) 33

The automotive service management course is designed to offer the students a practical orientation to the management functions of modern Dealerships or Service Centers. Accent is placed on those subjects that directly or indirectly influence the efficiency of the service department.
Prerequisite: Industrial Apprentice or Auto Mechanics.

A-AUT 1121 Braking Systems I 33

A complete study of various braking systems employed on automobiles and light weight trucks. Emphasis is placed on how they operate, proper adjustment, and repair.
Prerequisite: PHY 1102.

A-AUT 1122 Suspensions and Braking Systems II 33

This is an advanced course in modern up-to-date automotive suspensions and brakes. Basic suspension and brake service problems will be reviewed and followed by instruction on current power brake and disc brake systems, power steering systems, and suspension correction procedures for light-frame damage.
Prerequisite: A-AUT 1121

A-AUT 1123 Brakes, Chassis and Suspension 33

Principles and functions of the components of automotive chassis. Practical job instruction in adjusting and repairing of suspension, and steering systems. Units to be studied will be shock absorbers, springs, steering systems, steering linkage, and front end and alignment.
Prerequisite: PME 1102.

A-AUT 1124 Automotive Power Train Systems 33

Principles and functions of automotive power train systems: clutches, transmission gears, torque converters, drive shaft assemblies, rear axles and differentials. Identification of troubles, servicing, and repair.
Prerequisites: PHY 1102, AUT 1123.

A-AUT 1125 Automotive Diagnosis and Servicing 33

Emphasis is on the shop procedures necessary in determining the nature of troubles developed in the various component systems of the automobile. Troubleshooting of automotive systems, providing a full range of experinces in testing, adjusting, repairing and replacing.
Prerequisites: AUT 1123, AUT 1121, AHR 1101.

A-AHR 1101 Automotive Air Conditioning 22

General introduction to the principles of refrigeration; study of the assembly of the components and connections necessary in the mechanisms, the methods of operation, and control; proper handling of refrigerants in charging the system.
Prerequisite: PHY 1102.

A-AUT 1107 Automatic Transmissions I 44

This course is designed to give the student all the knowledge he needs to maintain and repair the hydramatic transmissions, and a general knowledge of the automatic transmission in common use.
Prerequisite: All basic auto courses.

A-AUT 1127 Automatic Transmissions II 22

This course is designed to give the student all the knowledge he needs to maintain and repair the Fordomatic, Mercomatic and Borg-Warner transmissions.
Prerequisite: All basic auto courses.

A-AUT 1128 Automatic Transmissions III 22

This coruse is designed to give the student all the knowledge he needs to maintain and repair the dynaflow, powerglide and power flight transmissions.
Prerequisite: All basic auto courses.

A-AUT 1110 Automotive Machine Shop 66

Students learn to restore worn automobile parts by using the various machine tools such as the cylinder boring bar, wrist pin fitters, crank shaft grinders, automatic transmission testers, auto and truck brake drum lathes and various tool room machines. Related technical information is given whenever needed to complete the various operations assigned. He should be able to repair or service minor ailments pertaining to the machinery he is working on.
Prerequisite: All basic auto courses.

DFT 1104 Blueprint Reading 33

Interpretation and reading of blueprints. Information on the basic principles of the blueprint; lines, views, dimensioning procedures and notes.
Prerequisite: None.

DFT 1105 Blueprint Reading: Mechanical 33

Further practice in interpretation of blueprints as they are used in industry; study of prints supplied by industry; making plans of operations; introduction to drafting room procedures; sketching as a means of passing on ideas, information and processes.
Prerequisite: DFT 1104.

MEC 1112 Machine Shop Processes 66

To acquaint the student with the procedures of layout work and the correct use of hand and machine tools. Experiences in the basic fundamentals of drill press and lathe operation; hand grinding of drill bits and lathe tools; set-up work applied to the trade.
Prerequisite: None.

A-MEC 1115 Treatment of Ferrous Metals 33

Investigates the properties of ferrous metals and tests to determine their uses. Instructions will include some chemical metallurgy to provide a background for the understanding of the physical changes and causes of these changes in metals. Physical metallurgy of ferrous metals, producing iron and steel, theory of alloys, shaping and forming, heat treatments for steel, surface treatments, alloy of special steel, classification of steels, and cast iron will be topics for study.
Prerequisite: None.

A-MEC 1116 Treatment of Non-Ferrous Metals 33

Continuation of the study of physical metallurgy. The non-ferrous metals: bearing metals, (brass, bronze, lead), light metals (aluminum and magnesium), and copper and its alloys are studied. Powder metallurgy, titanium, zirconium, indium, vanadium, and also plastics are included in this course.
Prerequisite: A-MEC 1115.

DFT 1101 Schematics and Diagrams: Power Mechanics 33

Interpretation and reading of blueprints. Development of ability to read and interpret blueprints, charts, instruction and service manuals, and wiring diagrams. Information on the basic principles of lines, views, dimensioning procedures, and notes.
Prerequisite: None.

WLD 1104 Basic Welding and Cutting 33

Welding demonstrations by the instructor and practice by students in the welding shop. Safe and correct methods of assembling and operating the welding equipment. Practice will be given for surface welding; bronze welding, silver soldering, and flame-cutting, arc and gas-arc welding methods applicable to mechanical repair work.
Prerequisite: None.

SERVICE TRADES   APPRENTICESHIP

MECHANICS & REPAIRMEN

DIESEL MECHANIC
(Diesel Vehicle Maintenance)
OE-NCES 17.1200

INTRODUCTION

Purpose of Program

This curriculum provides a training program for developing the basic knowledge and skills needed to inspect, diagnose, repair or adjust diesel powered equipment. Manual skills are developed in practical shop work. Thorough understanding of the operating principles involved in the modern internal combustion engine, chassis and suspensions, and power trains come in class assignments, discussion, and shop practice.

Complexity in diesel powered vehicles increases each year because of scientific discovery and new engineering. The use of diesel engines to power farm and construction equipment, electric generators, trucks, buses, trains, automobiles, and shops has been increasing. Many diesel vehicle mechanics specialize in maintenance and repair of equipment; others specialize in rebuilding engines that have operated for many hours. This curriculum provides a basis for the student to compare and adapt to new techniques for servicing and repair as engines and vehicles are changed year by year.

Career Opportunities

Diesel vehicle mechanics maintain and repair engines, chassis and suspensions, and power trains used to power farm equipment, construction equipment, buses, and trucks. They use handtools, precision measuring and testing instruments, and power tools in overhauling and maintaining diesel powered equipment.

DIESEL MECHANIC
(Diesel Vehicle Maintenance)
OE-NCES 17.1200

REQUIRED BASIC COURSES

No.	Title	Hours
ENG 1101	Reading Improvement	22
ENG 1102	Communication Skills	33
PHY 1101	Applied Science	33
PHY 1102	Applied Science	33
MAT 1101	Fundamentals of Mathematics	55
PSY 1101	Human Relations	33
DFT 1101	Schematics & Diagrams: Power Mechanics	33

REQUIRED RELATED COURSES

A-PME 1101	Internal Combustion Engines	33
A-PME 1102	Engine Electrical & Fuel Systems	55
A-PME 1103	Diesel Engine Servicing	33
A-PME 1121	Braking Systems	33
A-PME 1144	Power Trains	33
A-PME 1145	Chassis and Suspension Systems	33

ELECTIVE COURSES

A-AHR 1101	Automotive Air Conditioning	22
A-WLD 1102	Basic Arc Welding	33

SERVICE TRADES

MECHANICS & REPAIRMEN

DIESEL MECHANIC
(Diesel Vehicle Maintenance)
OE-NCES 17.1200

COURSE DESCRIPTIONS

No.	Title	Hours
DFT 1101	Schematics and Diagrams: Power Mechanics	33

Interpretation and reading of schematics and diagrams. Development of ability to read and interpret blueprints, charts, instruction and service manuals, and wiring diagrams. Information on the basic principles of lines, views, dimensioning procedures, and notes.
Prerequisite: None.

A-PME 1101	Internal Combustion Engines	33

Development of a thorough knowledge and ability in using, maintaining, and storing the various hand tools and measuring devices needed in engine repair work. Study of the construction and operation of components of internal combustion engines. Instruction is given in testing of engine performance; servicing and maintenance of pistons, valves, cams and camshafts, fuel and exhaust systems, cooling systems; proper lubrication; and methods of testing, diagnosing and repairing.
Prerequisite: None.

A-PME 1102	Engine Electrical & Fuel Systems	55

A thorough study of the electrical and fuel systems of the automobile. Battery cranking mechanism, generator, ignition, accessories and wiring; fuel pumps, carburetors, and fuel injectors. Characteristics of fuels, types of fuel systems, special tools, and testing equipment for the fuel and electrical system.
Prerequisite: A-PME 1101.

A-PME 1103	Diesel Engine Servicing	33

A study and practice in the servicing and repair of diesel engines and components. A study of fuels and special handling precautions, diesel fuel systems, injectors, pumps and controls. An advanced study of diesel engine principles, design, construction, reboring and installing of cylinder sleeves, and the operation of auxiliary engine controls.
Prerequisite: A-PME 1102.

A-PME 1121 Braking Systems 33

Braking principles are studied in relation to the coefficients of friction and heat, and the expansion of materials. The operating principles of hydraulic, pneumatic, combination, and vacuum brake systems are emphasized. Laboratory instruction is offered in the installation of brake lining and shoes, shoe reconditioning, drum turning, assembling and adjusting of brake systems and servicing of auxiliary units.
Prerequisite: None.

A-PME 1144 Power Trains 33

A study is made of types of gears, gear reduction ratios, gear combinations, bearings, types of clutches, drive lines, universals, and hydraulics as applied to power transmissions. Laboratory instruction is offered in the repair and servicing of clutches, fluid couplings and torque converters, standard power overdrive, multiple and automatic transmissions, drive lines and universal joints, and single speed and multi-speed final drive assemblies.
Prerequisite: A-PME 1102.
Corequisite: A-PME 1145.

A-PME 1145 Chassis and Suspension Systems 33

The principles involved in frame design, types of suspension, load weight distribution, types of steering, wheel alignment, and wheel balance are studied. The laboratory offers instruction in disassembly, inspection, reassembly, and adjustment of the components of frame and suspension systems.
Prerequisite: None.

A-AHR 1101 Automotive Air Conditioning 22

General introduction to the principles of refrigeration; study of the assembly of the components and connections necessary in the mechanisms, the methods of operation, and control; proper handling of refrigerants in charging the system.
Prerequisite: PHY 1102.

A-WLD 1102 Basic Arc Welding 33

Welding demonstrations by the instructor and practice by students in the use of the arc welding process to fabricate steel. Welded joints are discussed and welded in various positions. Care and maintenance of the arc welder are applied in this course.
Prerequisite: None.

SERVICE TRADES APPRENTICESHIP

MECHANICS & REPAIRMEN

DIESEL MECHANIC
(Heavy Equipment)
OE-NCES 17.1200

INTRODUCTION

Purpose of Program

In modern construction of industrial buildings, bridges, dams, highways, utility installations, airfields, and large shopping centers many types of heavy equipment are used. General adoption and widespread use of this modern heavy equipment has created numerous employment opportunities in preventative maintenance and repair. The development and application of earth moving machines has been an outstanding phase in our construction business, and especially in highway progress.

The Diesel Mechanic curriculum is designed to help students acquire knowledge and skills in "Troubleshooting" and repair of field equipment. This includes work on the internal combustion engines, and components of the mechines, such as gear trains, hydraulic systems and friction systems. Related subjects are included to give the student instruction in basic mathematics, letters and reports, print reading, human relations, and welding practice. Some knowledge of the operation of heavy equipment will be presented.

Career Opportunities

Graduates of this program may find employment with contractors that use heavy earth moving and other motorized construction equipment. This equipment may be used in highway construction and maintenance, quarries, strip mining, land clearing, building construction and industrial projects. Mechanics are used in areas of service, installation and preventative maintenance. They may make inspections and tests to determine the cause of faulty operation, and repair or replace defective parts to restore the machinery to proper operating condition. In many occasions they may be called upon to render service while the machinery is on the job. The state highway garages offer opportunities for heavy equipment mechanics since one third of all highway expenditures is for the purchase, operation and repair of motorized equipment.

MECHANICS & REPAIRMEN

DIESEL MECHANIC
(Heavy Equipment)
OE-NCES 17.1200

REQUIRED BASIC COURSES

No.	Title	Hours
ENG 1101	Reading Improvement	22
ENG 1102	Communication Skills	33
PHY 1101	Applied Science	33
PHY 1102	Applied Science	33
MAT 1101	Fundamentals of Mathematics	55
PSY 1101	Human Relations	33
DFT 1101	Schematics & Diagrams: Power Mechanics	33

REQUIRED RELATED COURSES - Heavy Equipment Maintenance

A-PME 1101	Internal Combustion Engines	33
A-PME 1102	Engine Electrical & Fuel Systems	55
A-PME 1104	Fuels & Lubricants	11
A-PME 1107	Gear Systems	33
A-PME 1108	Brake & Friction Systems	11
A-PME 1111	Vehicle Operation & Safety	11
A-PME 1123	Hydraulic & Cable Controls	33
A-PME 1141	Gear Systems	22
A-PME 1142	Gear Systems	11
A-PME 1146	Trouble Analysis & Service	33
A-WLD 1103	Welding	33

ELECTIVE COURSES - Heavy Equipment Maintenance

A-PME 1147	Reports and Records	22
BUS 1103	Small Business Operations	33

SERVICE TRADES

MECHANICS & REPAIRMEN

DIESEL MECHANIC
(Heavy Equipment)
OE-NCES 17.1200

COURSE DESCRIPTIONS

No. Title Hours

DFT 1101 Schematics and Diagrams: Power Mechanics 33

Interpretation and reading of schematics and diagrams. Development of ability to read and interpret blueprints, charts, instruction and service manuals, and wiring diagrams. Information on the basic principles of lines, views, dimensioning procedures, and notes.
Prerequisite: None.

A-PME 1101 Internal Combustion Engines 33

Development of a thorough knowledge and ability in using, maintaining, and storing the various hand tools and measuring devices needed in engine repair work. Study of the construction and operation of components of internal combustion engines. Instruction is given in testing of engine performance; servicing and maintenance of pistons, valves, cams and camshafts, fuel and exhaust systems, cooling systems; proper lubrication; and methods of testing, diagnosing and repairing.
Prerequisite: None.

A-PME 1102 Engine Electrical & Fuel Systems 55

A thorough study of the electrical and fuel systems of the automobile. Battery cranking mechanism, generator, ignition, accessories and wiring; fuel pumps, carburetors, and fuel injectors. Characteristics of fuels, types of fuel systems, special tools, and testing equipment for the fuel and electrical system.
Prerequisite: A-PME 1101.

A-PME 1104 Fuels & Lubricants 11

A basic analysis of petroleum products used as fuels and lubricants in present day equipment. Application of fuels and lubricants to the requirements of heavy equipment units.
Prerequisite: None.

A-PME 1107 Gear Systems 33

Angle drives, open gear universals. Troubleshooting, disassembly, inspection and final assembly. Laboratory models and actual earth moving equipment are used for shop projects.
Prerequisite: A-PME 1142.

A-PME 1108 Brake & Friction Systems 11

Theory and application of the coefficient of friction and kinetic energy applied to the braking systems. Practical applications in relining brakes, turning drums, installing and adjusting brakes.
Prerequisite: A-PME 1107.

A-PME 1111 Vehicle Operation & Safety 11

Connecting and disconnecting tractor and trailer, loading and unloading of heavy equipment. Driving and parking tractor trailer combination. Study of ICC regulations as to safety, maintenance and transportation of heavy equipment.
Prerequisite: None.

A-PME 1123 Hydraulic & Cable Controls 33

Review of fundamental hydraulic laws and practical application in rebuilding hydraulic systems, relining and adjusting brakes. Heavy duty brakes, vacuum assist and air brakes are emphasized. Theory and practice concerned with size and strength of cable and controls used in the various earthmoving equipment including proper usage of greases and lubricants.
Prerequisites: A-PME 1107, DFT 1101.

A-PME 1141 Gear Systems 22

A study of clutches, conventional transmissions, and automatic transmissions. Automatic transmission study consists of fluid units, torque converter principles, automatic controls and planetary gear systems. Disassembly, inspection of parts, reassembly of components. Drive line and final drive assemblies are included.
Prerequisite: None.

A-PME 1142 Gear Systems 11

Tractor and crawler transmissions; conventional, auxiliary and torque converters are stressed in theory and actual repair. Steering clutches and steering brakes are included.
Prerequisite: A-PME 1141.

A-PME 1146 Trouble Analysis & Service 33

Diagnosis of trouble and repair of components including the cooling systems, engines, electrical systems, gear trains, brakes, cables and controls on laboratory and field equipment. Preventative maintenance practices are stressed and use of report forms in preventative maintenance control is emphasized.
Prerequisites: A-PME 1107, A-PME 1108, A-PME 1102.
Corequisite: A-PME 1123.

A-WLD 1103 Welding 33

The various processes used for joining materials by welding are discussed. Lecture, demonstrations and practice cover the oxyacetylene and arc welding processes, filler metals used, gases, currents, weldability of metals. Instruction is given in the set-up and safe operation of oxyacetylene welding apparatus. Students prepare joints by both hand and machine cutting with the oxyacetylene torch.
Prerequisite: None.

A-PME 1147 Reports and Records 22

Principles and procedures involved in writing letters and reports. Analyzing and making out job, time and cost sheets. Use of shop orders and reports stressed as a working experience.
Prerequisite: None.

BUS 1103 Small Business Operations 33

An introduction to the business world, problems of small business operation, basic business law, business forms and records, financial problems, ordering and inventorying, layout of equipment and offices, methods of improving business, and employer-employee relations.
Prerequisite: None.

SERVICE TRADES APPRENTICESHIP

TEXTILE PRODUCTION

KNITTING MACHINE FIXER

OE-NCES 17.3399

INTRODUCTION

Purpose of Program

This guide outlines a training program for a skilled technical specialist, the knitting machine mechanic. The necessary training for this occupation is most important for the maintenance, repair, service and general upkeep of knitting machines.

This program was prepared to give the knitting machine mechanic broad experiences in all functions and operations of the knitting machine. The related instruction will provide the apprentice with technical knowledge to go with the manipulative skills acquired on the job, thus the apprentice will progress toward greater productive performance.

Career Opportunities

The trained knitting machine fixer will make knitting machine adjustments, be able to dismantle the machine and replace parts, install attachments, understand feeder mechanisms and be thoroughly familiar with chain set ups.

W 993E January, 1977

KNITTING MACHINE FIXER
OE-NCES 17.3399

REQUIRED BASIC COURSES

ENG 1101	Reading Improvement	22
ENG 1102	Communications Skills	33
ISC 1001	Industrial Safety	33
PSY 1101	Human Relations	33
MAT 1101	Fundamentals of Mathematics	55
PHY 1101	Applied Science I	55
PHY 1102	Applied Science II	55

REQUIRED RELATED COURSES

A-KNI 1101	Introduction to Basic Knitting	55
A-MEC 1105	Elements of Mechanics	33
A-MEC 1109	Knitting Machine Processes	88
A-MEC 1127	Pattern Making	55
A-MEC 2170	Materials & Processes	33

ELECTIVE COURSES

MAT 1103	Geometry	33
BUS 1103	Small Business Operations	33
BUS 1105	Industrial Organizations	33
ELC 1101	Applied Electricity	44
DFT 1104	Blueprint Reading	33
DFT 1105	Blueprint Reading: Mechanical	33

SERVICE TRADES

TEXTILE PRODUCTION

KNITTING MACHINE FIXER
OE-NCES 17.3399

COURSE DESCRIPTIONS

No.	Title	Hours
A-KNI 1101	Introduction to Basic Knitting	55

The history of high pile fabrics and their manufacture. Basic orientation to the knitting industry. Operation of knitting machinery and introduction of yarns, fibers, and colors.
Prerequisite: None.

No.	Title	Hours
A-MEC 1105	Elements of Mechanics	33

This will include the lubrication, the drive components, bearings, pumps, piping systems and basic elements of mechanics.
Prerequisite: None.

No.	Title	Hours
A-MEC 1109	Knitting Machine Processes	88

The theory and operation of the circular knitting machine and the general maintenance and repair of the machine.
Prerequisite: None.

No.	Title	Hours
A-MEC 1127	Pattern Making	55

Advance study in troubleshooting knitting machinery for repair and maintenance includes the setup and design of patterns.
Prerequisite: A-MEC 1105.

No.	Title	Hours
A-MEC 2170	Materials and Processes	33

An introductory study of the common materials used in industry and industrial processes. Identification, characteristics, use, and various other properties will be studied.
Prerequisite: None.

ELC 1101 Applied Electricity 44

Basic applications of electricity, types of electricity, methods of production, transmission and transforming of electrical energy. Topics presented are the fundamentals of direct and alternating currents, generators and motors, control circuits, protective devices, three phase current and voltage relationships, safety codes, installation and maintenance and practices of electrical machines.
Prerequisite: none.

DFT 1104 Blueprint Reading 33

Interpretation and reading of blueprints. Information on the basic principles of the blueprint; lines, views, dimensioning procedures and notes.
Prerequisite: None.

DFT 1105 Blueprint Reading: Mechanical 33

Further practice in interpretation of blueprints as they are used in industry; study of prints supplied by industry; making plans of operations; introduction to drafting room procedures; sketching as a means of passing on ideas, information and processes.
Prerequisite: DFT 1104.

MAINTENANCE MECHANICS
OE-NCES 17.1099

INTRODUCTION

Purpose of Curriculum

This curriculum is designed to prepare students to repair and maintain machinery, electrical wiring and fixtures, and hydraulics and pneumatic devices found in industrial establishments.

Career Opportunities

The maintenance mechanic may be required to install, maintain and service electrical and mechanical equipment. He should be able to follow directions from blueprints, sketches, manuals, and codes. He works with handtools and metal working machines, and checks the work with measuring and testing instruments. He operates metalworking machines, such as the lathe, milling machine and drill press to repair and make machine parts. He assembles wires, insulation, and electrical components using handtools and soldering equipment. He tests electrical circuits and components to locate shorts, faulty connections, and defective parts, using test meters. He installs machine parts, starts machines, observes operation, and inspects the machine with test instruments. He also inspects and tests hydraulic equipment after new installations or repairs.

MAINTENANCE MECHANICS
OE-NCES 17.1099

REQUIRED BASIC COURSES

No.	Title	Hours
ENG 1101	Reading Improvement	22
ENG 1102	Communication Skills	33
ISC 1001	Industrial Safety	33
PSY 1101	Human Relations	33
MAT 1101*	Fundamentals of Mathematics	55
BUS 1105*	Industrial Organizations	33

REQUIRED RELATED COURSES

ELC 1101	Basic Electricity	22
ELC 1103	Electricity (Industrial Machines)	22
DFT 1104*	Blueprint Reading	33
DFT 1113*	Blueprint Reading: Electrical	33
MAT 1115	Electrical Mathematics	55
WLD 1104	Basic Welding & Cutting	33
A-MEC 1101*	Machine Shop Theory and Practice	33
A-MEC 1102	Machine Shop Theory and Practice	33
A-MEC 1133	Machine Maintenance I	33
A-MEC 1134	Machine Maintenance II	33

ELECTIVE COURSES

PHY 1101	Applied Science	55
PHY 1102	Applied Science	55
PHY 1122	Rigging	33
MAT 1116	Electrical Mathematics	55
MAT 1123	Machinist Mathematics	33
A-DFT 1121	Elementary Drafting	66
A-MEC 1115	Treatment of Ferrous Metals	33
A-MEC 1116	Treatment of Non-Ferrous Metals	33
A-MEC 1126	Metallurgy-Heat Treating Practice	33

* Apprentices with advanced credit should select another course.

BUILDING AND MAINTENANCE TRADES

MAINTENANCE MECHANICS
OE-NCES 17.1099

COURSE DESCRIPTIONS

No. Title Hours

ELC 1101 Basic Electricity 22

This course covers the elementary principles of electricity, including units and terms, Ohm's Law, power, and types of electricity with specific application to the operation of electrical devices.
Prerequisite: None

ELC 1103 Electricity (Industrial Machines) 22

The fundamentals of basic electricity (direct and alternating current) are reviewed with work on the following topics: series and parallel circuits, electrical power and energy, wire sizes, magnetism, and the principles of motors, generators and transformers. Single-phase and three phase circuits, and synchronous motor operation are discussed.
Prerequisite: ELC 1101 or PHY 1101.

DFT 1104 Blueprint Reading 33

Interpretation and reading of blueprints. Information on the basic principles of the blueprint; lines, views, dimensioning procedures and notes.
Prerequisite: None.

DFT 1113 Blueprint Reading: Electrical 33

Interpretation of schematics, diagrams and blueprints applicable to electrical installations with emphasis on electrical plans for domestic and commercial buildings. Sketching schematics, diagrams, and electrical plans for electrical installations using appropriate symbols and notes according to the applicable codes will be a part of this course.
Prerequisite: DFT 1110.

MAT 1115 Electrical Mathematics 55

A study of fundamental concepts of algebra; basic operations of addition, subtraction, multiplication, and division; solution of first order equations, use of letters and signs, grouping, factoring, exponents, ratios, and proportions; solution of equations, algebraically and graphically; a study of logarithms and use of tables; and introduction to trigonometric functions and their application to right angles; and a study of vectors for use in alternating current.
Prerequisite: MAT 1101 or equivalent.

WLD 1104 Basic Welding & Cutting 33

Welding demonstrations by the instructor and practice by students in the welding shop. Safe and correct methods of assembling and operating the welding equipment. Practice will be given for surface welding; bronze welding, silver soldering, arc and gas-arc welding methods applicable to mechanical repair work.
Prerequisite: None.

A-MEC 1101 Machine Shop Theory and Practice 33

An introduction to the machinist trade and the potential it holds for craftsmen. Deals primarily with the identification, care and use of basic hand tools and precision measuring instruments. Elementary layout procedures and processes of lathe, drill press, grinding (off-hand) and milling machines will be introduced in theory only.
Prerequisite: None.

A-MEC 1102 Machine Shop Theory and Practice 33

Advanced operation in layout tools and procedures, power sawing, drill press, surface grinder, milling machine shaper. The student will study the basic operations on the cylindrical grinder and will select tools and procedures to be used.
Prerequisite: A-MEC 1101.

A-MEC 1133 Machine Maintenance I 33

To acquaint the student with the basic fundamentals of installation, maintenance and repair of miscellaneous electrical, mechanical, hydraulic, pneumatic and lubrication devices. Methods of rigging and machine installation including location, leveling and fastening are covered. The use of precision measuring tools and checking for accuracy, squareness and correct center line distances is stressed for pre-start inspection.
Prerequisites: MEC 1102, DFT 1102, DFT 1113.
Corequisite: ELC 1101.

A-MEC 1134 Machine Maintenance II 33

A study is made of those parts of the electrical code which affect the work of the industrial maintenance electrician. Practical study of wiring, installing and connecting the various types of services for lighting, heating and power installations. Troubleshooting procedures, the identification and testing of circuits, making mechanical adjustments, and related maintenance operations on various machines are covered. Schematic diagrams showing the plan of operation for each system, electrical or mechanical, are used.
Prerequisite: A-MEC 1133.

MAT 1116 Electrical Mathematics 55

This course contains a wide range of practical electrical problems selected to insure mastery of the basic principles of mathematics essential to the electrical trade. These problems are corrolated with the electrical principles that are involved in this course.

Prerequisite: MAT 1101.

MAT 1123 Machinist Mathematics 33

Introduces gear ratio, lead screw and indexing problems with emphasis on application to the machine shop. Practical applications and problems furnish the trainee with experience in geometric propositions and trigonometric relations to shop problems; concludes with an introduction to compound angle problems.

Prerequisite: MAT 1101.

A-DFT 1121 Elementary Drafting 66

An introduction to drafting and the study of drafting practices. Instruction is given in the selection, use and care of instruments, single-stroke lettering, applied geometry, freehand sketching consisting of orthographic and pictorial drawings. Orthographic projection, reading and instrument drawing of principal views, single auxiliary views (primary), and double (oblique) auxiliary views will be emphasized. Dimensioning and note practices will be studied with reference to the American Standards Association practices. Methods of reproducing drawings will be included at the appropriate time.

Prerequisite: None.

A-MEC 1115 Treatment of Ferrous Metals 33

Investigates the properties of ferrous metals and tests to determine their uses. Instructions will include some chemical metallurgy to provide a background for the understanding of the physical changes and causes of these changes in metals. Physical metallurgy of ferrous metals, producing iron and steel, theory of alloys, shapping and forming, heat treatments for steel, surface treatments, alloy of special steel, classification of steels, and cast iron will be topics for study.

Prerequisite: None.

A-MEC 1116 Treatment of Non-Ferrous Metals 33

Continuation of the study of physical metallurgy. The non-ferrous metals: bearing metals, (brass, bronze, lead), light metals (aluminum and magnesium), and copper and its alloys are studied. Power metallurgy, titanium, zirconium, indium, vanadium, and also plastics are included in this course.

Prerequisite: MEC 1115.

A-MEC 1126 Metallurgy-Heat Treating Practice 33

Working knowledge of the methods of treating ferrous and non-ferrous metals. The effects of hardening, tempering, and annealing upon the structure and physical properties of metals. Trainees will be given the opportunity to acquaint themselves with the equipment and processes of heat treating. Prerequisite: MEC 1124 or equivalent.

FARM MACHINERY
OE-NCES 17.0303

INTRODUCTION

Purpose of Program

The history of the development and introduction of farm machinery is largely the history of what we call "modern civilization." The introduction of tools to cultivate the soil and lighten the labor of the farmer was immediately reflected in an improvement of the standard of living. The major factor in this growth and development has been the replacement of horsepower by power developed from gasoline and electricity.

As agriculture has become mechanized the need for trained specialists has increased. The hoe and scythe or the horse-drawn plow and rake required little repair or serivce that could not be provided on the farm. Modern machinery, however, is complicated and intricate and its general adoption and widespread use have created new areas of business opportunity.

This program is organized to provide a broad training to permit entrance into the field best suited to the interest and aptitude of the graduate. Emphasis is placed on the basic fundamental theory and related laboratory and shop techniques with specialization to be developed later in employment.

Career Opportunities

Graduates of this program can quickly adapt themselves for employment in the areas of sales, service, distribution, installation and maintenance. They may estimate cost and plan equipment installations or provide the service that must be done, not in the factory, but in the field, and done by personnel who thoroughly understand the problems of the farmer-purchaser.

They will make inspections and tests to determine the causes of faulty operation, and repair or replace defective parts to restore the tractor or other gasoline-powered equipment to proper operating condition. They may occasionally be called upon to render service on other types of equipment such as pumps and sprayers, barn and diary equipment, ventilation and electrical equipment found on the farm.

MECHANICS & REPAIRMEN

FARM MACHINERY
OE-NCES 17.0303

REQUIRED BASIC COURSES

No.	Title	Hours
ENG 1101	Reading Improvement	22
ENG 1102	Communications Skills	33
MAT 1101	Fundamentals of Mathematics	55
PHY 1101	Applied Science	55
PHY 1102	Applied Science	55
PSY 1101	Human Relations	33
ISC 1001	Industrial Safety	33
BUS 1103	Small Business Operations	33

REQUIRED RELATED COURSES

No.	Title	Hours
A-PME 1101	Internal Combustion Engines	33
A-PME 1102	Engine Electrical & Fuel Systems	55
A-PME 1113	Farm Machinery Hydraulic Systems	33
A-PME 1114	Farm Machinery Power Trains	33
A-PME 1115	Farm Machinery Suspensions and Implements	33
A-PME 1116	Farm Machinery Service and Repair	33
DFT 1101	Schematics & Diagrams: Power Mechanics	33
WLD 1101	Basic Gas Welding	33
WLD 1102	Basic Arc Welding	33

ELECTIVE COURSES

No.	Title	Hours
DFT 1104	Blueprint Reading	33
DFT 1105	Blueprint Reading: Mechanical	33
MEC 1112	Machine Shop Processes	66
A-MEC 1115	Treatment of Ferrous Metals	33
A-MEC 1116	Treatment of Non-Ferrous Metals	33

SERVICE TRADES

MECHANICS & REPAIRMEN

FARM MACHINERY
OE-NCES 17.0303

COURSE DESCRIPTIONS

No. Title Hours

A-PME 1101 Internal Combustion Engines 33

Development of a thorough knowledge and ability in using, maintaining, and storing the various hand tools and measuring devices needed in engine repair work. Study of the construction and operation of components of internal combustion engines. Instruction is given in testing of engine performance; servicing and maintenance of pistons, valves, cams and camshafts, fuel and exhaust systems, cooling systems; proper lubrication; and methods of testing, diagnosing and repairing.
Prerequisite: None.

A-PME 1102 Engine Electrical and Fuel Systems 55

A thorough study of the electrical and fuel systems of the automobile. Battery cranking mechanism, generator, ignition, accessories and wiring; fuel pumps, carburetors, and fuel injectors. Characteristics of fuels, types of fuel systems, special tools, and testing equipment for the fuel and electrical system.
Prerequisite: A-PME 1101.

A-PME 1113 Farm Machinery Hydraulic Systems 33

A concentrated investigation of tractor hydraulic systems consisting of hydraulic principles and components of various hydraulic systems. Hydrostatics, basic circuits, fluids, hydrodynamics and automatic draft control. Identification of trouble, servicing, and repair.
Prerequisite: A-PME 1101.

A-PME 1114 Farm Machinery Power Trains 33

Principles and functions of tractor power train systems: clutches, bearings, shafts, and cases, gears and gear trains, differentials, final drives, and planetary systems.
Prerequisite: A-PME 1101.

A-PME 1115 Farm Machinery Suspensions and Implements 33

Principles and functions of the components of tractor suspensions. Practical instruction in adjustment and repair of suspension, steering braking, and hitching systems.

Students will receive instruction in assembly, adjustment , operation, maintenance and repair of tractor-drawn and mounted equipment. They will also study the principles of operation and diagnosis and correction of troubles in tillage, planting and seeding, pest control and harvesting equipment.
Prerequisite: A-PME 1101.

A-PME 1116 Farm Machinery Service and Repair 33

Opportunity for the student to practice principles and techniques learned in previous courses by means of service and repair work that can be made available. A close simulation to an actual farm machinery shop situation will be maintained, and effort will be made to give the student a full range of testing and servicing experience under both shop and field conditions.
Prerequisite: A-PME 1101.

DFT 1101 Schematics and Diagrams: Power Mechanics 33

Interpretation and reading of schematics and diagrams. Development of ability to read and interpret blueprints, charts, instruction and service manuals, and wiring diagrams. Information on the basic principles of lines, views, dimensioning procedures, and notes.
Prerequisite; None.

WLD 1101 Basic Gas Welding 33

Welding demonstrations by the instructor and practice by students in the welding shop. Safe and correct methods of assembling and operating the welding equipment. Practice will be given for surface welding; bronze welding, silver soldering, and flame-cutting methods applicable to mechanical repair work.
Prerequisite: None.

WLD 1102 Basic Arc Welding 33

Welding demonstrations by the instructor and practice by students in the use of the arc welding process to fabricate steel. Welded joints are discussed and welded in various positions. Care and maintenance of the arc welder are applied in this course.
Prerequisite: None.

DFT 1104 Blueprint Reading 33

Interpretation and reading of blueprints. Information on the basic principles of the blueprint; lines, views, dimensioning procedures and notes.
Prerequisite: None.

DFT 1105 Blueprint Reading: Mechanical 33

Further practice in interpretation of blueprints as they are used in industry; study of prints supplied by industry; making plans of operations; introduction to drafting room procedures; sketching as a means of passing on ideas, information and processes.
Prerequisite: DFT 1104.

MEC 1112 Machine Shop Processes 66

To acquaint the student with the procedures of layout work and the correct use of hand and machine tools. Experiences in the basic fundamentals of drill press and lathe operation; hand grinding of drill bits and lathe tools; set-up work applied to the trade.
Prerequisite: None.

A-MEC 1115 Treatment of Ferrous Metals 33

Investigates the properties of ferrous metals and tests to determine their uses. instructions will include some chemical metallurgy to provide a background for the understanding of the physical changes and causes of these changes in metals. Physical metallurgy of ferrous metals, producing iron and steel, theory of alloys, shaping and forming, heat treatments for steel, surface treatments, alloy of special steel, classification of steels, and cast iron will be topics for study.
Prerequisite: None.

A-MEC 1116 Treatment of Non-Ferrous Metals 33

Continuation of the study of physical metallurgy. The non-ferrous metals: bearing metals, (brass, bronze, lead), light metals (aluminum and magnesium), and copper and its alloys are studied. Powder metallurgy, titanium, zirconium, indium, vanadium, and also plastics are included in this course.
Prerequisite: A-MEC 1115.

ELECTRICAL APPLIANCE SERVICING
OE-NCES 17.0200

INTRODUCTION

Purpose of Program

With the ever increasing number of electrical appliances found in the home and in industrial applications, it is necessary that the electrical appliance repairman understand a wide variety of electrical and mechanical techniques.

The electric appliance repairman may be required to install, maintain and service a wide variety of home and commercial appliances. His/her work will require him/her to meet the public both in the repair shop and on service calls. A serviceman who establishes his/her own business will also need to know how to maintain business records and inventory.

Job opportunities awaiting a graduate of this course are varied--such jobs as independent repair shop, appliance retail stores, and business maintenance repairman.

Career Opportunities

The graduate of Electrical Appliance Servicing will be qualified to do repair on small electrical appliances as well as the large appliances in the home as well as in the shop. The student will be taught the fundamental theory of operation, the proper methods of diagnosing service problems, and how to make the necessary repairs. The student will have an understanding of basic electrical theory, small appliances, electric motors, heating equipment, laundry equipment, and domestic refrigeration and air conditioning. The student will be taught how to meet customers in the shop and in the home and how to deal with them in customer relations. The student will receive in addition training in establishing and maintaining a small business.

ELECTRICAL APPLIANCE SERVICING
OE-NCES 17.0200

REQUIRED BASIC COURSES

No.	Title	Hours
ENG 1101	Reading Improvement	22
ENG 1102	Communication Skills	33
MAT 1101	Fundamentals of Mathematics	55
ISC 1001	Industrial Safety	33
PSY 1101	Human Relations	33
BUS 1103	Small Business Operations	55

REQUIRED RELATED COURSES

A-AHR 1107	Air Conditioning and Refrigeration	110
A-BPR 1110	Blueprint Reading - Electrical	22
A-ELN 1117	Heating Equipment and Controls: Electrical	66
A-ELN 1120	Small Appliances	55
A-ELN 1135	Direct and Alternating Current	55
A-ELN 1136	Electric Motors	55
A-ELN 1137	Laundry Equipment	66
A-MAT 1106	Electrical Mathematics	55

ELECTIVE COURSES

MAT 1103	Geometry	33
PHY 1101	Applied Science I	55

ELECTRICAL APPLIANCE SERVICING
OE-NCES 17.0200

COURSE DESCRIPTIONS

No.	Title	Hours
A-AHR 1107	Air Conditioning and Refrigeration	110

A basic study of the theory of refrigerants used in domestic refrigeration. Also a study of the different components and their function. Stressed in this course will be safety, testing, troubleshooting, and replacement of parts.
Prerequisite: None.

No.	Title	Hours
A-BPR 1110	Blueprint Reading - Electrical	22

A study of the different types of diagrams and schematics to prepare the student to read them.
Prerequisite: None.

No.	Title	Hours
A-ELN 1117	Heating Equipment and Controls: Electrical	66

A study of basic heating units found in many electric appliances. This will also include hot water heaters, electric ranges, ovens and surface units, and portable electric heaters. Theory of operation, repair, and replacement will be taught.
Prerequisite: None.

No.	Title	Hours
A-ELN 1120	Small Appliances	55

A study of the many types of small appliances found in the home and in some industrial locations. This study will include such equipment as toasters, mixers, steam and dry irons, fryers and fans. Theory of operation as well as repair and maintenance will be taught.
Prerequisite: None.

No.	Title	Hours
A-ELN 1135	Direct and Alternating Current	55

A study of basic atomic structure, attraction and repulsion, Ohm's law and current flow.
Prerequisite: None.

A-ELN 1136 Electric Motors 55

This is a study of the different types of electric motors found on domestic as well as commercial appliances. There will be a study of repair and maintenance on series motor split phase and capacitor start motors.
Prerequisite: None.

A-ELN 1137 Laundry Equipment 66

A study of home laundry products including wringer washers, automatic washers of different types, driers and dishwashers. The theory, operation, maintenance and repair will be taught.
Prerequisite: None.

A-MAT 1106 Electrical Mathematics 55

An introductory algebra course with trigonometry and vectors needed in alternating current: algebraic operations of addition, subtraction, multiplication and division; use of letters and signs, grouping, factoring; exponents, ratios and proportions; algebraic and graphic solutions of first-degree equations; introduction to trigonometric functions, their graphs and applications to right triangles. Addition, subtraction and resolution of vector quantities.
Prerequisite: None.

SEWING MACHINE REPAIRMAN
OE-NCES 17.0500

INTRODUCTION

Purpose of Program

The rapid growth of the garment industry in North Carolina during the past decade has created a shortage of mechanics to maintain and service the industrial sewing machines. The sewing machine mechanic is generally known as a technical specialist. He/she may be assigned fifty or more sewing machines to maintain, service, and repair when they have malfunctions. He/she must know how to diagnose the trouble, dismantle and repair or replace and adjust the parts that are malfunctioning.

This program guide was prepared to give the trainee maintenance experiences in all parts of the modern industrial sewing machines. The courses provide for the related instruction that will give the trainee experiences in both the technical knowledge and manipulative skills needed to make repairs on various industrial sewing machines. The trainee needs to possess patience and forebearance in order to cope with these difficult problems incountered in repairing and reassembling a sewing machine to make it operate correctly.

Career Opportunities

The trainee or the apprentice is normally employed as a helper to a power-sewing-machine mechanic. He/she assists the Sewing Machine Mechanic in repairing and adjusting sewing machines, using hand tools. When he/she has satisfactorily completed the appranticeship, he/she becomes a regular mechanic.

The mechanic makes adjustments to regulate the length of stroke of the needle and the horizontal movement of feeding mechanism under the needle. He/she dismantles machines and replaces or repairs broken or worn parts. He/she inspects the machines, shafts and belts, and installs broken transmission belts when required.

The mechanic should be able to install special attachments on the various machines. He/she may initiate orders for new machines or parts for replacements. He/she may operate machine tools, such as lathes, drill presses and other machine shop tools to make new parts.

SEWING MACHINE REPAIRMAN
OE-NCES 17.0500

REQUIRED BASIC COURSES

No.	Title	Hours
ENG 1101	Reading Improvement	22
ENG 1102	Communication Skills	33
MAT 1101	Fundamentals of Mathematics	55
ISC 1101	Industrial Safety	33
PSY 1101	Human Relations	33

REQUIRED RELATED COURSES

A-MEC 1226	Sewing Machines - Overedging Stitch	44
A-MEC 1227	Single Thread Stitches	44
A-MEC 1228	Two Thread Stitches	44
A-MEC 1229	Three Thread Stitches	44
A-MEC 1230	Four Thread or Fancy Stitches	22
A-MEC 1231	Sewing Machine Needles	22
A-MEC 1232	Sewing Machine Yarn and Thread	44
A-MEC 1233	Sewing Machine Nomenclature	22
A-MEC 1234	Sewing Machine Feeding Devices	22
A-MEC 1235	Sewing Machine Timing	22
A-MEC 1236	Sewing Machine Stitch Formation	22
A-MEC 1237	Dismantling and Reassembling Procedures I	44
A-MEC 1238	Dismantling and Reassembling Procedures II	44
A-MEC 1239	Diagnosing Trouble in Sewing Machines I	22
A-MEC 1240	Diagnosing Trouble in Sewing Machines II	22

ELECTIVE COURSES

A-MEC 1201	Machine Processes	33
A-MEC 1202	Machine Processes	33

NOTE: After each repair or adjustment the machine must be tested on the Sewing Machine Stand.

SEWING MACHINE REPAIRMAN
OE-NCES 17.0500

COURSE DESCRIPTIONS

No. **Title** **Hours**

A-MEC 1226 Sewing Machines - Overedging Stitch 44

This course gives an overview of the development of the industrial type sewing machines and the overedging stitch. There are four types of machines to become acquainted with as follows: Single Thread - Type 501; Two Thread - Type 502 and 503; Three Thread - Type 504 and 505; and the Four Thread - Type 506.
Prerequisite: None.

A-MEC 1227 Single Thread Stitches 44

The following single thread stitches are studied in conjunction with Type 501 Machines:

1. Ordinary running stitch used in basting
2. Back stitch
3. Fast stitch
4. Chain stitch
5. Coiled loop chain stitch
6. Knitted loop chain stitch
7. Knotted loop chain stitch
8. Loop enchained by second alternate stitch
9. Each loop locks and enchains alternate loops
10. Staple stitch for waxed threads

Prerequisite: None.

A-MEC 1228 Two Thread Stitches 44

The following two-thread stitches are studied in conjunction with Types 502 and 503 machines.

1. Double needle chain stitch
2. Double thread chain stitch, two threads, one needle
3. Double looped stitch. Grover and Baker
4. Chain with interlocking thread
5. Under thread through its own loop
6. Two needles penetrate fabric from opposite sides
7. Two needles working from the same side of fabric
8. Doubly interlocking loop
9. Lockstitch
10. Coil in shuttle thread
11. Double coil in shuttle thread
12. Knot stitch; every stitch knotted
13. Knot stitch (different knot)
14. Shuttle thread drawn up to form embroidery
15. Wire lock; thread locked by wire

Prerequisite: A-MEC 1227.

A-MEC 1229 Three Thread Stitches 44

The following three thread stitches are studied in conjunction with Types 504 and 505 machines:

1. Two shuttles, each locking alternate loops
2. Double loop with interlocking third thread
3. Two shuttle threads locking each loop
4. Two shuttle threads intertwining and locking each loop
5. Single thread. Loop of needle thread drawn up over the edge and locked by needle at its next descent
6. Two threads. Brights of needle thread, above and below, extend to the edge of the fabric, and are locked by shuttle thread
7. Two threads, needle penetrates back from edge, its loop passed to, and interlocked by, the needle at its next descent over the edge, and this second needle loop locked by shuttle thread
8. Shuttle thread drawn up over the edge of the fabric to the line of the needle thread
9. Needle loop through the fabric locked by needle loop over the edge and second loop locked by second thread
10. Two threads. Edge of fabric covered by shuttle thread
11. Third thread laid under the stitch at the edge of the fabric

Prerequisite: A-MEC 1227 and A-MEC 1228.

A-MEC 1230 Four Threads, or Fancy Stitches 22

The following four thread or fancy stitches are studied in conjunction with Type 506 machines:

1. Various of above described stitches made zigzag
2. Single faced or straw braid, zigzag or herringbone stitches
3. Single faced or straw braid stitches
4. Embroidering stitches
5. Saddler's stitch

Prerequisite: A-MEC 1229.

A-MEC 1231 Sewing Machine Needles 22

The history of the needle is reviewed, and also, the nomenclature and terminology of the modern needle is identified. Needles are studied when working with each type of sewing machines. The following terms or parts should be defined and also, the parts should be labeled on an enlarged sketch of a needle:

1. Bronze, knitting, eye-pointed groove, double, groove, slab shank, set point, scarf, special groove, flat blade
2. Point, eye, spot, scarf or land, blade, shank, butt, groove or grooves.

Prerequisite: None.

A-MEC 1232 Sewing Machine Yarn and Thread 44

There are two types of fibers from which man makes yarn and thread: Man-made and Natural. There are three systems used to determine yarn or thread.

1. English or hank system
2. Denier system
3. Mercerized cotton thread

Prerequisite: None.

A-MEC 1233 Sewing Machine Nomenclature 22

Terminology and nomenclature should be used from the first day in classes. The apprentice should try to learn several new sewing machine terms and their use every day. Review on nomenclature can be done as any spelling of terms or words. The students should keep the terms and definitions in their notebooks.
Prerequisite: None.

A-MEC 1234 Sewing Machine Feeding Devices 22

The following feeding devices should be identified, studied, and adjusted for correct use:

1. Drop Feed
2. Differential Feed
3. Underwheel Feed
4. Top and Underwheel Feed
5. Cup Feed
6. Top and Caup Feed
7. Top Walking Feed
8. Needle Feed
9. Compound Feed
10. Puller Feeds
11. Ruffling Devices
    - Upper feed
    - Upperwheel feed
    - Universal feed
    - Union feed
    - Reversible feed

Prerequisite: None.

A-MEC 1235 Sewing Machine Timing 22

The ability to correctly time a sewing machine is one of trade "kinks" a trainee must learn to accomplish. The following are essential things to regulate in timing a machine: needle travel; looper travel and hook gauge. Each machine must pass the test on the sewing stand after the adjustment has been completed.
Prerequisite: A-MEC 1226.

A-MEC 1236 Sewing Machine Stitch Formation 22

The stitch formation is studied and adjustments made on as many as possible of the following machines:

1. Type 101
2. Type 300
3. Types 400 & 401
4. Type 600
5. Type 406
6. Type 604
7. Type 500
8. Reece - 52
9. Union - 52900
10. Union - 150
11. Singer - 246-2
12. Union - 61900
13. Singer - 242-2

Prerequisites: All courses involving these machines.

A-MEC 1237 Dismantling and Reassembling Procedures I 44

Using the single needle Type 101 machine as an example, the dismantling and reassembling procedures are given to the trainee. The learner then proceeds to dismantle the machine, check and repair parts if needed, and then reassemble for testing on the stand. Then he should proceed to work with other single and double thread stitching machines.
Prerequisite: A-MEC 1236.

A-MEC 1238 Dismantling and Reassembling Procedures II 44

Using the multiple needle machines such as types 502, 503, 504, 505, and 506, the dismantling and reassembling procedures are given to the trainee in order of progress. All parts are checked for wear and malfunction, and repaired when needed. After the machines are reassembled, they are tested on the sewing machine stand.
Prerequisite: A-MEC 1237.

A-MEC 1239 Diagnosing Trouble in Sewing Machines I 22

Identifying Causes of Thread Breaking:

1. Short staples
2. Oil hook
3. Improper setting of needle bar
4. Needle breakage
5. Bobbin breakage
6. Feed motion
    a. Dirt or lint
    b. Too low
    c. Too high

To correct the thread breaking:

1. Needle check
    a. Tip of needle - to see if bent
    b. See that needle inserted up in right place
2. Check hook
    a. Clean hook of all scars
    b. Clean hook basket and gibb
3. Foot off
4. Needle plate
5. Feeder
6. New needle
7. Time hook

Prerequisite: A-MEC 1227 thru A-MEC 1229.

A-MEC 1240 Diagnosing Trouble in Sewing Machines II 22

Skip Stitching - How to check the malfunction without going into machine:

1. Check needle - replace old needle
2. Check tension
3. Check feed motion
4. Check feed dog for dirt
5. Check spring

Bad Stitches - Causes:

1. Thread
2. Tight or loose top thread
3. Poor timing
    a. Needle bar is timed by machine
    b. Hook is not timed to eye of needle or close enough
    c. Needle is not timed to feeder

Prerequisite: A-MEC 1239.

SURVEYING
OE-NCES 16.0106

Purpose of Program

This curriculum is designed to give students knowledge of the fundamentals of surveying. The curriculum covers the legal principles of boundary controls as well as practical surveying.

Plane, land, topographical, route, building and road construction surveying are supplemented by courses in mapping, drafting, blueprint reading, applied mathematics, communication skills and human relations.

Career Opportunities

An individual upon completion of this program should qualify for various jobs such as Instrument Man, Party Chief, Notekeeper, Draftsman, or Inspector. These jobs are available through highway departments, city governments, U. S. Coast & Geodetic Survey Department and private engineering and surveying concerns.

CIVIL TECHNOLOGY

SURVEYING

OE-NCES 16.0106

REQUIRED BASIC COURSES

No.	Title	Hours
ENG 1101	Reading Improvement	22
ENG 1102	Communication Skills	33
MAT 1101	Fundamentals of Mathematics	55
PSY 1101	Human Relations	33
ISC 1001	Industrial Safety	33
BUS 1103	Small Business Operations	33
PHY 1101	Applied Science	55
PHY 1102	Applied Science	55

REQUIRED RELATED COURSES

A-DFT 1146	Drafting I	55
A-DFT 1147	Drafting II	55
A-DFT 1148	Drafting III	55
A-CIV 1101	Surveying I	55
A-CIV 1102	Surveying II	55
A-CIV 1103	Surveying III	55
A-CIV 1104	Surveying IV	55
A-CIV 1105	N.C. Survey Law	55
A-CIV 1106	Building Sites Survey	55
A-CIV 1107	Construction of Highways	55
A-CIV 1108	Planning and Estimating I	55
A-CIV 1109	Planning and Estimating II	55
A-CIV 1110	Seminar-Project	33

ELECTIVE COURSES

A-DFT 1107	Drafting IV	33
A-ECO 1103	Economics-Highway Emphasis	55
A-SCI 1102	Chemistry of Soils, Bituminous Materials	55

CIVIL TECHNOLOGY

SURVEYING
OE-NCES 16.0106

COURSE DESCRIPTIONS

No. Title Hours

A-DFT 1146 Drafting I 55

Introduction to drafting and the study of drafting practices. Instruction in the selection, use and care of instruments, sketching orthographic and pictorial drawing. Orthographic projections, and principal views.
Prerequisite: None.

A-DFT 1147 Drafting II 55

Introduction to the comprehensive interpretation of construction drawing. How to read pictorial and orthographic drawings. Reading elevations, structural plans, symbols, notes, scales, construction types.
Prerequisite: A-DFT 1146.

A-DFT 1148 Drafting III 55

Plats as required by law drawn in pencil and ink. Highway construction layouts and profiles, steel and wood structural drawings, topographical mapping and symbols.
Prerequisites: A-DFT 1146, and A-DFT 1147.

A-CIV 1101 Surveying I 55

Care and use of instruments, theory and practice of plane surveying including taping, differential and profile leveling, transit, stadia, and transit-tape surveys.
Prerequisite: None.

A-CIV 1102 Surveying II 55

Triangulation of ordinary precision, use of plane table, calculation of areas of land, land surveying, topographic surveys and mapping. Introduction to use of calculators.
Prerequisite: A-CIV 1101.

A-CIV 1103 Surveying III 55

Route surveys by ground and aerial methods. Simple, compound, reverse parabolic and spiral curves. Geometric design of highways, highway surveys and plans including mass diagrams.
Prerequisites: A-CIV 1101 and A-CIV 1102.

A-CIV 1104 Surveying IV 55

Positioning of construction facilities, land plot surveys, modern instrumentation and electronic surveying principles. Surveying practice will be an integral part of this course with hypothetical as well as real cases for the practical experience of the trainees.
Prerequisites: A-CIV 1101, A-CIV 1102 and A-CIV 1103.

A-CIV 1105 North Carolina Survey Law 55

A study of the laws of land surveying as related to the State of North Carolina will be covered as well as laws and common practice as related to lands on Federal Reserve (Qualla Boundary).
Prerequisite: None.

A-CIV 1106 Building Sites Survey 55

Procedures of locating properties, evaluating evidence, procedures to describe property, to create land divisions, and to prepare plots. Building site surveys, plaris shots and sun shots will be covered and attempted by the trainees.
Prerequisites: A-CIV 1101, A-CIV 1102, A-CIV 1103 and A-CIV 1104.

A-CIV 1107 Construction of Highways 55

Construction practices for road building, including soil properties, grading, base, subbase, drainage, cuts and fills, design of intersections, study of traffic flow and surveys, timespace diagrams. Organizational structure of the national highway system.
Prerequisites: A-CIV 1101, A-CIV 1102, A-CIV 1103 and A-CIV 1104.

A-CIV 1108 Planning and Estimating I 55

Introduction to construction planning and estimating. Analysis of layout requirements and contractors' organizations for highway projects, construction scheduling, project control and supervision.
Prerequisite: None.

A-CIV 1109 Planning and Estimating II 55

A continuation of CIV 1108 (Planning and Estimating I) giving special attention to those areas of study required to support the Seminar Project.
Prerequisite: A-CIV 1108.

A-CIV 1110 Seminar-Project

33

The seminar project is designed to provide the student with an opportunity to select, plan, and develop a comprehensive project combining the skills learned into a workable proposal. Projects, where possible, will be selected from area needs where there is a possibility of future implementation.
Prerequisites: A-CIV 1106 and A-CIV 1107.

A-DFT 1107 Drafting IV

33

An extension of Drafting III with the opportunity to pursue basic projects on an individual basis. Advanced drafting as related to land plats. Including plot drafting as related to the use of field notes. Hypothetical as well as real cases will be included.
Prerequisites: A-DFT 1146, A-DFT 1147 and A-DFT 1148.

A-ECO 1103 Economics-Highway Emphasis

55

Designed to help the student understand present-day economic problems. Topics include production, consumption, exchange and distribution, money and credit, business fluctuations, labor and management relations and challenges to our system of free enterprise. Emphasis on each topic will be its relation to the economics of road construction.
Prerequisite: None.

A-SCI 1102 Chemistry of Soils and Bituminous Materials

55

The student will concentrate on these aspects of chemical theory and practice that relate to the tests that must be performed in the field to properly evaluate the properties of soils and bituminous materials associated with the highway construction. Study of soil types and the subsurface investigation. Earth pressure theories, bearing capacity, stability of slopes, hydrostatics of ground water, methods of compaction and consolidation.
Prerequisite: None.

APPRENTICESHIP EDUCATION

SUGGESTED BIBLIOGRAPHY

A comprehensive list of materials, by curriculum, subgrouped by textbooks and self-study or programmed materials and alphabetized by title, is included in this section. More information can be obtained by writing directly to the publisher or producer. Addresses appear in the source listing at the end of this section.

AIR CONDITIONING

Textbooks

Air Conditioning
by E.P. Anderson
Audel

Basic Electricity
by Van Valkenburgh, Nooger & Neville
Rider

Basic Mathematic Simplified
by Olivo & Olivo
Delmar

Modern Air Conditioning Practice
by N. C. Harris & D.F. Conde
McGraw-Hill

Principles of Air Conditioning
by V.P. Lang
Delmar

Sheet Metal Blueprint Reading for Building Trades
by C.J. Zinngrabe
Delmar

Welding Processes
by Griffin & Roden
Delmar

Self-Study or Programmed Materials

Basic and Advanced Arc Welding
(Programmed)
Westinghouse

Basic Electricity (Programmed)
by C.W. Ryan
Wiley

Basic Mathematics (Programmed)
by Smith
Encyclopedia Britannica Press

Basic Mathematics Simplified (Self-study)
by Olivo & Olivo
Delmar

Climate Control Technology
Xerox Learning Systems

Unit 12010-82	Overview of the Climate Control Industries
Unit 12020-82	Refrigeration Cycle
Unit 12040-82	Refrigeration Components
Unit 12050-82	Refrigerants
Unit 12070-82	Wiring Diagrams & Controls
Unit 12080-82	Control Circuit Testing
Unit 12100-82	Installation & Maintenance

Welding Processes (Self Study)
by Griffin & Roden
Delmar

Principles of Air Conditioning (Self-Study)
by V.P. Long
Delmar

Sheet Metal Blueprint Reading for Building Trades (Self-Study)
by C.J. Zinngrabe
Delmar

AUTO BODY REPAIRMAN

Textbooks

Automotive Collision Work
by Spicer
American Technical Society

Auto Body Repairing and Repainting
by Toboldt
Goodheart-Willcox

Collision Repair Guide
by MacPherson
Gregg/McGraw-Hill

Modern Welding
by Althouse, Turnquist & Bowditch
Goodheart-Willcox

Practical Problems in Math-Automotive Techniques
by Dwiggins
Delmar

Principles of Auto Body Repairing, Repairing and Repainting
by Tait, Deroche & Hildibrand
Prentice-Hall

Total Autobody Repair
by Rhone
Sams

Self-Study or Programmed Materials

Automotive Body Repair (Programmed)
Hoffman

Automotive Painting (Programmed)
Hoffman

Collision Repair Guide (Self-Study)
by MacPherson
Gregg/McGraw-Hill

Practical Problems in Math-Automotive Technicians (Self-Study)
by Dwiggins
Delmar

Basic and Advanced Arc Welding (Programmed)
Westinghouse

AUTOMOTIVE MECHANIC

Textbooks

Auto Mechanics Fundamentals
by Stockel
Goodheart-Willcox

Automatic Transmissions
by Brejcha
American Technical Society

Automotive Air Conditioning
by Dwiggins
Delmar

Automotive Drawing Interpretation
by Jensen
Delmar

Automotive Electrical Systems
by Billiet & Goings
American Technical Society

Automotive Maintenance and Trouble Shooting
by Goings & Spicer
American Technical Society

Automotive Oscilloscope
by Whited
Delmar

Automotive Science
by Jersen, Brazier & Hill
Delmar

Automotive Service & Repair Tools
by Hill
Delmar

Automotive Starting & Charging Systems
by Dwiggins
Delmar

Automotive Steering Systems
by Dwiggins
Delmar

Automotive Suspensions, Steering Alignment and Brakes
by Billiet & Alley
American Technical Society

Disc and Drum Brake Service
by Alley & Billiet
American Technical Society

Fuel, Lubricating and Cooling Systems
by Crouse & Anglin
Gregg/McGraw-Hill

Interpreting Automotive Systems
by Hill
Delmar

Solid-State Ignition Systems
by Graf & Whalen

Welding Processes
by Griffin & Roden
Delmar

Self-Study or Programmed Materials

Automotive Air Conditioning (Self-Study)
by Dwiggins
Delmar

Automotive Drawing Interpretation
by Jensen
Delmar

Automotive Science (Self-Study)
by Jensen/Brazier & Hill
Delmar

Automotive Service & Repair Tools (Self-Study)
by Hill
Delmar

Automotive Starting & Charging Systems (Self-Study)
by Dwiggins
Delmar

Automotive Steering Systems (Self-Study)
by Dwiggins
Delmar

Automotive Suspensions, Steering Alignment & Brakes (Self-Study)
by Billie A. Alley

Automotive Technology - Overview (Programmed)
Xerox Learning Systems
Unit 10010-80 Fasteners and Couplings
Unit 10020-80 Basic Hand Tools
Unit 10030-80 Basic Physical Principles
Unit 10040-80 Electrical System Fundamentals
Unit 10050-80 Fundamentals of Engine Operation
Unit 10060-80 Engine Fuel, Lubrication and Cooling Systems
Unit 10070-80 Measuring Devices
Unit 10080-80 Operation of Engine Electrical Systems
Unit 10090-80 Transmission, Drive Shaft and Axle Operation
Unit 10100-80 Suspension System Fundamentals

Unit 10110-80	Safety in the Auto Shop
Unit 10120-80	Automotive Tune Up Procedure
Unit 10130-80	Automotive Trouble - Shooting Procedure
Unit 10140-80	Overview of the Automotive Industry
Unit 10150-80	Brake Systems Fundamentals
Unit 10160-80	Brake Parts Replacement Procedures
Unit 10170-80	Disc Brake Fundamentals
Unit 10180-80	Fuel System Fundamentals
Unit 10190-80	Electrical Wiring Diagrams
Unit 10200-80	Ignition System Fundamentals
Unit 10210-80	Steering System Fundamentals
Unit 10220-80	Automotive Lubricants and Fuels
Unit 10240-80	Rotary Engine Fundamentals
Unit 10250-80	Wheels and Tires
Unit 10260-80	Principles of Carburetion
Unit 10270-80	Fundamentals of Air Conditioning
Unit 10280-80	Principles of Standard Transmission

Interpreting Automotive Systems (Self-Study)
by Hill
Delmar

Welding Processes (Self-Study)
by Griffin & Roden
Delmar

BRICKLAYING AND MASONRY

Textbooks

The Art of Bricklaying
by J. E. Ray
Bennett

Bricklaying Vocational Training
by W. F. Roark
Brick Institute of America

Bricklaying Skill & Practice
by R. Putnam
American Technical Society

Bricklaying I & II
Delmar

Building Trades Blueprint Reading & Sketching
Delmar

Concrete and Masonry Techniques and Design
by R. J. DeCristoforo
Reston

Masonry Skills
by R. T. Kreh
Delmar

Plan Reading for Brickmasons
Brick Institute of America

Practical Problems in Mathematics for Masons
by J. E. Ball
Delmar

Self-Study or Programmed Materials

Blueprint Reading (Programmed)
by J. D. Heisel
McGraw-Hill

Bricklaying I & II (Self-Study)
Delmar

Building Trades Blueprint Reading & Sketching (Self-Study)
Delmar

Masonry Skills (Self-Study)
by R. T. Kreh
Delmar

Practical Problems in Mathematics for Masons
by J. E. Ball
Delmar

CARPENTRY AND CABINETMAKING

Textbooks

Accident Prevention Manual for Shop Teachers
by William A. Williams
American Technical Society

Basic Carpentry
by John Capotosto
Reston

Bench Woodwork
by John L. Feirer
Bennett

Blueprint Reading and Sketching for Carpenters - Residential
by Leo R. McDonnell & John E. Ball
Delmar

Building Construction - Materials and Types of Construction
by Whitney C. Huntington & Robert E. Mickadeit
Wiley & Sons

Cabinetmaking and Millwork
by John L. Feirer
Bennett

Cabinetmaking and Millwork: Tools, Materials, Layout, and Construction
by Alf Dahl & J. Douglas Wilson
American Technical Society

Carpentry and Building Construction
by John L. Feirer & Gilbert R. Hutchings
Bennett

Commercial Carpentry
Oklahoma State Department of
Vocational & Technical Education

Concrete Form Construction
Delmar

Construction Estimating
by Raymond P. Jones
Delmar

Estimating for the Building Trades
by Joseph Steinberg & Martin Stempel
American Technical Society

Estimating in Building Construction
by Frank R. Dagostino
Reston

Exterior and Interior Trim
by John E. Ball
Delmar

Foundation Construction
by Author B. Carson
McGraw-Hill

Framing, Sheathing, and Insulation
by Raymond R. Jones
Delmar

Hand Woodworking Tools
by Leo P. McDonnel
Delmar

Insulation Manual for Houses and Apartments
National Association of Home Builders

Manual of Accident Prevention in Construction
The Associated General Contractors of America

Methods and Materials of Residential Construction
by Wass
Reston

Modern Carpentry
by Willis H. Wagner
Goodheart-Willcox

North Carolina State Building Code
North Carolina Department of Insurance

Power Tool Maintenance
by Daniel W. Irvin
McGraw-Hill

Practical Problems in Mathematics for Carpenters
by Jack Luy
Delmar

Simplified Roof Framing
by J. Douglas Wilson & S.O. Werner
McGraw-Hill

Simplified Stair Layout
by J. Douglas Wilson
Delmar

Stair Layout
by Stanley Bradzinski
American Technical Society

Steel Square
by Gilbert Townsend
American Technical Society

Welding Processes
by Griffin & Roden
Delmar

Self-Study or Programmed Materials

Basic and Advanced Arc Welding (Programmed)
Westinghouse

Blueprint Reading (Programmed)
by J.D. Heisel
McGraw-Hill

Blueprint Reading and Sketching for Carpenters - Residential (Self-Study)
by Leo R. McDonnel & John E. Ball
Delmar

Building Trades Blueprint Reading and Sketching (Self-Study)
Delmar

Concrete Form Construction (Self-Study)
Delmar

Construction Estimating (Self-Study)
by Raymond P. Jones
Delmar

Exterior and Interior Trim (Self-Study)
by John E. Ball
Delmar

Framing, Sheathing, and Insulation (Self-Study)
by Raymond R. Jones
Delmar

Hand Woodworking Tools (Self-Study)
by Leo P. McDonnel
Delmar

Light Construction Techniques (Programmed)
by John E. Ball
Howard Sams
(12 programs with 35-mm slides and cassette tapes as follows)

1) Foundations I - Slab-on-Grade
2) Foundations II - Crawl Space, Basement, and Piles
3) Framing I - Floor and Wall Framing
4) Framing II - Roof Framing
5) Roofing - Asphalt Strip Shingles, Wood Shakes, and Built-up Roofs
6) Exterior Sidewall I - Brick Veneer and Fireplace Construction
7) Exterior Side Wall II - Wood Lap, Metal Lap, Plywood, and Hardboard

8) Interior Wall Finish I - Gypsum Wallboard, Ceramic Tile, and Paneling
9) Interior Wall Finish II and Ceilings - Wallpaper, Plaster, Suspended Ceilings, and Ceiling Tile
10) Cabinet Construction
11) Interior Trim and Stair Construction - Base, Ceiling, Window and Door
12) Floor Covering - Carpet, Resilient, and Hardwood

Welding Processes (Self-Study)
by Griffin & Roden
Delmar

CEMENT MASONRY

Textbooks

Building Trades Blueprint Reading & Sketching
Delmar

Concrete and Masonry Techniques and Design
by R. J. DeCristoforo.
Reston

Concrete Technology
Delmar

How To Work with Concrete and Masonry
by Darrell Huff
Harper & Row

Masonry Simplied
by R. Dalzell & G. Townsend
American Technical Society

Masons and Builders Library
by Louis Dezettel
Audel

Practical Problems in Mathematics for Masons
by T. S. Kubala
Delmar

Self-Study or Programmed Materials

Building Trades Blueprint Reading & Sketching (Self-Study)
Delmar

Concrete Technology (Self-Study)
Delmar

Practical Problems in Mathematics for Masons
by T. S. Kubala
Delmar

DIESEL MECHANICS

Textbooks

Basic Mathematics Simplified
by Olivo & Olivo
Delmar

Diesel and High Compression Gas Engines
by Kates & Lucks
American Technical Society

Diesel Fundamentals, Service, Repair
by Tobolt
Goodheart-Willcox

Disc and Drum Brake Service
by Alley & Billiet
American Technical Society

Fluid Powers
by Johnson
American Technical Society

Fuel, Lubricating and Cooling Systems
by Crouse & Anglin
Gregg/McGraw-Hill

Practical Problems in Math
by Dwiggins
Delmar

Solid-State Ignition Systems
by Graf & Whalen
Sams

Welding Processes
by Griffin & Roden
Delmar

Self-Study or Programmed Materials

Basic & Advanced Arc Welding (Programmed)
Westinghouse

Basic Mathematics (Programmed)
by Smith
Encyclopedia Britannica Educational Corp.

Basic Mathematics Simplied (Self-Study)
by Olivo & Olivo
Delmar

Diesel Engine Fundamentals (Programmed)
Numer 10240-80
Xerox Learning Systems

Engine Fuel, Lubrication and Cooling Systems (Programmed)
number 10060-80
Xerox Learning Systems

Ignition Systems Fundamentals (Programmed)
Number 10200-80
Xerox Learning Systems

Steering Systems Fundamentals (Programmed)
Number 10210-80
Xerox Learning Systems

Welding Processes (Self-Study)
by Griffin & Roden
Delmar

ELECTRICAL APPLIANCE SERVICING

Textbooks

Appliance Service Handbook
by Meyerink
Prentice-Hall

Basic Principles of Electricity
by Robinson
Reston

Circuit Concepts: Direct & Alternating
by Kubala
Delmar

Electric Controls for Refrigeration and Air Conditioning
by Langley
Prentice-Hall

Electric Motors
by Anderson
Sams

Electrical Appliance Servicing: Vols. I & II
by Ruel & Nolte
Gregg/McGraw-Hill

Electrical Blueprint Reading
by Traister
Sams

Home Refrigeration and Air Conditioning
by Anderson
Sams

How To Repair Electrical Appliances
by Wheeler
Reston

Practical Problems in Mathematics for Electricians
by Kubala
Delmar

Self-Study or Programmed Materials

Basic Mathematics (Programmed)
by Smith
Encyclopedia Britannica Press

Climate Control Technology (Programmed)
Xerox Learning Corporation
Unit 12070-82 Wiring Diagrams and Controls
Unit 12080-82 Control Circuit Testing
Unit 12100-82 Installation & Maintenance

Major Appliance Repair
Hoffman

Practical Problems in Mathematics for Electricians (Self-Study)
by Kubala
Delmar

ELECTRICAL INSTALLATION

Textbooks

American Electricians Handbook
by Croft, Carr & Watt
McGraw-Hill

Basic Electricity
by Van Valkenburgh, Nooger & Neville
Rider

Basic Mathematics for Electricity & Electronics
by Singer
McGraw-Hill

National Electric Code
National Electrical Contractors Association

Self-Study or Programmed Materials

AC Circuit Analysis (Self-Study)
by N. C. Lockhart & O. E. Rice
Delmar

Alternating Current Fundamentals (Self-Study)
by J. R. Duff
Delmar

Basic Electricity (Programmed)
by C. W. Ryan
Wiley

Basic Electronics (Programmed)
New York Institute of Technology
McGraw-Hill

Circuit Concepts: Direct & Alternating Current (Self-Study)
by T. S. Kubala
Delmar

Direct Current Fundamentals (Self-Study)
by O. E. Loper
Delmar

Electric Motor Control (Self-Study)
by W. E. Alerich
Delmar

Electrical Concepts (Programmed)
by V. Robinson
Reston

Electrical Wiring: Commercial (Self-Study)
by R. C. Mullin & R. C. Smith
Delmar

Electrical Wiring: Residential (Self-Study)
by R. C. Mullin
Delmar

Electricity I: Devices, Circuits, Materials (Self-Study)
by T. S. Kubala
Delmar

Electricity II: Devices, Circuits, Materials (Self-Study)
by T. S. Kubala
Delmar

Electricity III: Motors, Generators, Controls (Self-Study)
by W. N. Alerich
Delmar

Electricity IV: Motors, Generators, Controls (Self-Study)
by W. N. Alerich
Delmar

Practical Problems in Mathematics for Electricians (Self-Study)
by Kubala
Delmar

ELECTRICAL LINEMAN

Textbooks

Advanced First Aid & Personal Safety
American Red Cross

Basic Blueprint Reading & Sketching
by Olivo & Payne
Delmar

Basic Electrical Power Distribution
by Pansini
Hayden

Basic Electrical Power Transmission
by Pansini
Hayden

Electric Power Transmission System
by Wildi
Buck Engineering

Electrical Machinery
by Fitzgerald
McGraw-Hill

Emergency Medical Guide
by Henderson
McGraw-Hill

First Aid and Emergency Rescue
by Erven
Glencoe Press

First Aid, Diagnosis and Management
by Cole
Appleton-Century-Crofts

The Lineman's and Cableman's Handbook
by Kurtz
McGraw-Hill

Standard First Aid & Personal Safety
American Red Cross

FARM MACHINERY

Textbooks

Basic Arc Welding
by Griffin & Roden
Delmar

Basic Oxyacetylene Welding
by Griffin & Roden
Delmar

Compact Tractor Service Manual Vols I & II
Sams

Diesel Engine Manual
by Black
Sams

Farm Machinery Manuals
John Deere

International Harvester
Massey Ferguson
Ford

Fluid Power: Theory & Application
by Sullivan
Prentice-Hall

Fundamentals of Service
John Deere Service Publications

Light Utility Tractor Service Manual
Sams

Machine Shop Operations & Setups
by Lascoe, Nelson & Porter
American Technical Society

Metallurgy
by Johnson & Weeks
American Technical Society

Power Mechanics
by Atteberry
Goodheart-Willcox

Principles of Farm Machinery
by Kepner, Bainer & Barger
A.V.I. Publishing Co.

Small Engines Service Manual
Sams

Self-Study or Programmed Materials

Basic Arc Welding
by Griffin & Roden
Delmar

Basic Oxyacetylene Welding
by Griffin & Roden
Delmar

Servicing Small Gasoline Engines
by Palma
Sams
No. 25595 Engine Disassembly & Inspection
No. 25596 Engine Reassembly
No. 25597 Tune-Up

KNITTING MACHINE FIXER

Textbooks

Basic Blueprint Reading & Sketching
by Olivo & Payne
Delmar

Basic Electricity
by Van Valkenbury, Nooger & Neville
Rider

Blueprint Reading for Machinists - Intermediate
Delmar

Knitting Machinery
by J. R. Critser, Jr.
Lexington Data

Knitting Technology & Manual
by H. Wignall
Textile BK.

Practical Problems in Mathematics for Machinists
by Bradley
Delmar

Textile Machine Manufacturer's Manuals

Programmed or Self-Study Materials

Basic Blueprint Reading & Sketching (Self-Study)
by Olivo & Payne
Delmar

Basic Electricity (Programmed)
by C. W. Ryan
Wiley

Blueprint Reading for Machinists - Intermediate
Delmar

Practical Problems in Mathematics for Machinists
by Bradley
Delmar

MACHINIST

Textbooks

A First Course in Geometry
by Walsh
Holt, Rinehart & Winston

Algebra & Trigonometry
by Cameron
Holt, Rinehart & Winston

Basic Blueprint Reading & Sketching
by Olivo & Payne
Delmar

Basic Electricity
by Van Valkenburgh, Nooger & Neville
Rider

Blueprint Reading for Machinists - Intermediate
Delmar

Grinding Technology
by Krar & Oswald
Delmar

Machine Shop Operations & Setups
by Lascoe, Nelson & Porter
American Technical Society

Machine Shop Series
Vol. I Bench Work
Vol. II Drill Press Work
Vol. III Heat Treatment of Metals
Vol. IV Milling Machine Work
Delmar

Metallurgy
by Johnson & Weeks
American Technical Society

Practical Problems in Mathematics for Machinists
by Bradley
Delmar

Turning Technology
by Krar & Oswald
Delmar

Welding Processes
by Griffin & Roden
Delmar

Programmed or Self-Study Materials

Basic Blueprint Reading & Sketching (Self-Study)
by Olivo & Payne
Delmar

Basic Electricity (Programmed)
by C.W. Ryan
Wiley

Basic & Advanced Arc Welding (Programmed)
Westinghouse

Blueprint Reading for Machinists - Intermediate (Self-Study)
Delmar

Grinding Technology (Self-Study)
by Krar & Oswald

Machine Shop Safety Kit (Programmed)
Slides & Cassett Tapes - 2 modules
by Wasiloff
McGraw-Hill

Machine Shop Series
Vol. I Bench Work
Vol. II Drill Press Work
Vol. III Heat Treatment of Metals
Vol. IV Milling Machine Work
Delmar

Plane Geometry (Programmed)
by Jurgensen
Houghton Mifflin

Practical Problems in Mathematics for Machinists (Self-Study)
by Bradley
Delmar

Trigonometry (Programmed)
by Selby
McGraw-Hill

Turning Technology (Self-Study)
by Krar & Oswald
Delmar

Welding Processes (Self-Study)
by Griffin & Roden
Delmar

MAINTENANCE MECHANICS

Textbooks

Basic Blueprint Reading & Sketching
by Olivo & Payne

Basic Electricity
by Van Valkenburg, Nooger & Neville
Rider

Control of Electric Machines
by L. Kosow
Prentice-Hall

Machine Shop Series
Vol. I Bench Work
Vol. II Drill Press Work
Vol. III Heat Treatment of Metals
Vol. IV Milling Machine Work

Metallurgy
by Johnson & Weeks
American Technical Society

National Electrical Code Blueprint Reading
by Gehert
American Technical Society

Practical Problems in Math Series
Electricians
Machinists
Delmar

Welding Processes
by Griffin & Roden
Delmar

Programmed or Self-Study Materials

Basic and Advanced Arc Welding (Programmed)
Westinghouse

Basic Blueprint Reading and Sketching (Self-Study)
by Olivo & Payne
Delmar

Blueprint Reading for Machinists - Intermediate
Delmar

Machine Shop Safety Kit (Programmed)
Slide & Cassett Tapes 2 modules
by Wasiloff
McGraw-Hill

Machine Shop Series (Self-Study)
Vol. I Bench Work
Vol. II Drill Press Work
Vol. III Heat Treatment of Metals
Vol. IV Milling Machine Work
Delmar

Practical Problems in Mathematics for Machinists (Self-Study)
by Bradley
Delmar

Welding Processes (Self-Study)
by Griffin & Roden
Delmar

MECHANICAL DRAFTSMAN

Textbooks

Blueprint Reading: Interpretation of Mechanical Working Drawings
by W. J. Hornung
Prentice-Hall

Descriptive Geometry
by Hawk
McGraw-Hill

Drafting Technology
by Horton & Rotmans
Delmar

Machine Shop Operations and Setups
by Lascoe, Nelson & Porter
American Technical Society

Mechanical Drafting Essentials
by McCabe, Keith & Farnham
Prentice-Hall

Metallurgy Theory and Practice
by Allen
American Technical Society

Modern Shop Procedures
by Kratfel & Drake
Prentice-Hall

Small Business Management - Books 1 & 2
by Hailes & Hubbard
Delmar

Self-Study or Programmed Materials

Basic Blueprint Reading & Sketching (Self-Study)
by Olivo & Payne
Delmar

Blueprint Reading for Machinists - Intermediate (Self-Study)
Delmar

Blueprint Reading for Machinists - Advanced (Self-Study)
Delmar

Drafting Technology (Programmed)
Unit 14010-84 Overview of Drafting
Unit 14020-84 Drafting Instruments
Unit 14030-84 Orthographic Projection
Unit 14040-84 Basic Drafting Techniques
Unit 14050-84 Sectional and Auxiliary Views
Unit 14060-84 Dimensioning Concepts - 1
Unit 14070-84 Dimensioning Concepts - II
Unit 14080-84 Tolerences
Unit 14090-84 Drawing Format and Content
Unit 14100-84 Lettering
Xerox Learning Systems

Small Business Management - Books I & II
by Hailes & Hubbard
Delmar

METAL FABRICATION

Textbooks

Basic Arc Welding
by Griffin & Roden
Delmar

Basic Blueprint Reading & Sketching
by Olivo & Payne
Delmar

Basic Oxyacetylene Welding
by Griffin & Roden
Delmar

Blueprint Reading for Welders
by Bennett & Sly
Delmar

Machine Shop Operations and Setups
by Lascoe, Nelson & Porter
American Technical Society

Metallurgy
by Johnson & Weeks
American Technical Society

Sheet Metal Hand Processes
by Zinngrabe & Schumacher
Delmar

Sheet Metal Machine Processes
by Zinngrabe & Schumacher
Delmar

Practical Layout for Sheet Metal Shop
by Zinngrabe & Schumacher
Delmar

Self-Study or Programmed Materials

Basic and Advanced Arc Welding (Programmed)
Westinghouse

Basic Arc Welding (Self-Study)
by Griffin & Roden
Delmar

Basic Oxyacetylene Welding (Self-Study)
by Griffin & Roden (Delmar)

Basic Blueprint Reading & Sketching (Self-Study)
by Olivo & Payne
Delmar

Basic Machine Shop Series (Self-Study)
Delmar

Blueprint Reading for Welders (Self-Study)
by Bennett & Sly
Delmar

Practical Layout for Sheet Metal Shop
by Zinngrabe & Schumacher
Delmar

Sheet Metal Hand Processes (Self-Study)
by Zinngrabe & Schumacher
Delmar

Sheet Metal Machine Processes (Self-Study)
by Zinngrabe & Schumacher
Delmar

PAINTING AND DECORATING

Textbooks

Basic Blueprint Reading & Sketching
By Olivo & Payne
Delmar

Building Trades Blueprint Reading
Delmar

Coloring, Finishing and Painting Wood
by Newell & Holtrop
Bennett

Construction Estimating
by Jones
Delmar

Finishing Technology
by Soderberg
McKnight

Interior Painting, Wallpapering and Paneling
by Wheeler
Prentice-Hall

Painting and Decorating Encyclopedia
Goodheart - Willcox

Wood Finishing
by Jeffrey
Bennett

Self-Study or Programmed Materials

Basic Blueprint Reading & Sketching (Self-Study)
by Olivo & Payne
Delmar

Building Trades Blueprint Reading (Self-Study)
Delmar

Construction Estimating (Self-Study)
by Jones
Delmar

Light Construction Techniques (Programmed)
by Ball
No. 25586 Interior Wall Finish I
No. 25587 Interior Wall Finish II and Ceilings

PLUMBING AND PIPEFITTING

Textbooks

Basic Mathematics Simplified
by Olivo & Olivo
Delmar

Blueprint Reading for Plumbers
by B. Darcangelo & J.R. Guess
Delmar

How To Design and Install Plumbing
by A. J. Matthias & E. Smith
American Technical Society

Low Pressure Boilers
by F. M. Steingress
American Technical Society

Plumbers and Pipe Fitters Library, 3 Vols.
by J. Oravetz
Audel

Plumbing I
by H. Slater
Delmar

Plumbing II
by H. Slater
Delmar

Templet Development for the Pipe Trades
by R. P. Jones
Delmar

Self-Study or Programmed Materials

Basic & Advanced Arc Welding (Programmed)
Westinghouse

Blueprint Reading for Plumbers (Self-Study)
by B. D'arcangelo & J. R. Guess
Delmar

Pipefitting (Programmed)
Dupont Education Division
  Course No. 8 Pipe & Fitting Identification
  Course No. 9 Measurement and Layout
  Course No.10 Sample and Rolling Offsets
  Course No.123 Manually Cutting and Reaming Pipe
  Course No.64 Layout Practices

Plumbing I Self-Study)
by H. Slater
Delmar

Plumbing II (Self-Study)
by H. Slater
Delmar

Templet Development for Pipe Trades
by R. P. Jones
Delmar

REFRIGERATION

Textbooks

Basic Electricity
by Van Valkenburgh, Nooger & Neville
Rider

Basic Mathematics Simplified
by Olivo & Olivo
Delmar

Blueprint Reading Series
Delmar

Commercial Refrigeration
by E.P. Anderson
Audel

Electric Controls for Refrigeration and Air Conditioning
by B.C. Langley
Prentice-Hall

Principles of Refrigeration
by R. W. Marsh & C. T. Olivo
Delmar

Refrigeration Servicing
by P. F. Goliber
Delmar

Welding Processes
by Griffin & Roden
Delmar

Self-Study or Programmed Materials

Basic and Advanced Arc Welding (Programmed)
Westinghouse

Basic Electricity (Programmed)
by C. W. Ryan
Wiley

Basic Mathematics (Programmed)
by J. A. Smith
Encyclopedia Britannica Press

Basic Mathematics Simplified (Self-Study)
by Olivo & Olivo
Delmar

Blueprint Reading Series
Delmar

Climate Control Technology (Programmed)
Xerox Learning Systems
- Unit 12020-82 Refrigeration Cycle
- Unit 12040-82 Refrigeration Components
- Unit 12050-82 Refrigerants
- Unit 12070-82 Wiring Diagrams and Controls
- Unit 12080-82 Control Circuit Testing
- Unit 12100-82 Installation and Maintenance

Principles of Refrigeration (Self-Study)
by R. W. Marsh & C. T. Olivo
Delmar

Refrigeration Servicing
by P.F. Goliber
Delmar

Welding Processes (Self-Study)
Griffin & Roden
Delmar

SEWING MACHINE REPAIRMAN

Textbooks

Machine Design
by Hall, Holowenko & Laughlin
McGraw-Hill

Equipment Manufacturer's Manuals

SHEET METAL

Textbooks

Introduction to Modern Sheet Metal
by E. R. Kratfel
Reston

Mathematics for Sheet Metal Fabrication
Delmar

Practical Layout for the Sheet Metal Shop
by Zinngrabe & Schumacher
Delmar

Sheet Metal Blueprint Reading for Building Trades
by Claude & Zinngrabe
Delmar

Sheet Metal Hand Processes
by Zinngrabe & Schumacher
Delmar

Sheet Metal Machine Processes
by Zinngrabe & Schumacher
Delmar

Sheet Metal Shop Practice
by C. W. Hall
American Technical Society

Welding Processes
by Griffin & Roden
Delmar

Self-Study or Programmed Materials

Basic and Advanced Arc Welding (Programmed)
Westinghouse

Basic Mathematics
by J. A. Smith
Encylopedia Britannica Educational Corporation

Mathematics for Sheet Metal (Self-Study)
Delmar

Practical Layout for the Sheet Metal Shop (Self-Study)
by Zinngrabe & Schumacher
Delmar

Sheet Metal Blueprint Reading for Building Trades (Self-Study)
by Claude & Zinngrabe
Delmar

Sheet Metal Hand Processes (Self-Study)
by Zinngrabe & Schumacher
Delmar

Sheet Metal Machine Processes (Self-Study)
by Zinngrabe & Schumacher
Delmar

Welding Processes
by Griffin & Roden
Delmar

SURVEYING

Textbooks

Construction Estimates From Take-Off To Bid
by Foster
McGraw-Hill

Elementary Plane Surveying
by Davis
McGraw-Hill

General Drafting
by Blum
McGraw-Hill

Introduction to Construction Drafting
by Hooper
Prentice-Hall

Soil: Mechanics and Engineering
by Scott & Schoustra
McGraw-Hill

Surveying Practice
by Kissam
McGraw-Hill

Surveying: Theory and Practice
by Davis, Foote & Kell
McGraw-Hill

Self-Study or Programmed Materials

Drafting Technology
Xerox Learning Systems

Unit 14010-84	Overview of Drafting
Unit 14020-84	Drafting Instruments
Unit 14030-84	Orthographic Projection

Unit 14040-84	Basic Drafting Techniques
Unit 14050-84	Sectional and Auxiliary Views
Unit 14060-84	Dimensioning Concepts - I
Unit 14070-84	Dimensioning Concepts - II
Unit 14080-84	Tolerances
Unit 14090-84	Drafting Format & Content
Unit 14100-84	Lettering

TOOL AND DIE MAKING

Textbooks

Advanced Die Making
Gregg/McGraw-Hill

Basic Die Making
Gregg/McGraw-Hill

Blueprint Reading for Machinists - Advanced
Delmar

Industrial Hydraulics
by Pippenger & Hicks
Gregg/McGraw-Hill

Jig & Fixture Design Vols. I & II
Delmar

Machine Tool Operations
by Patton
Prentice-Hall

Plastics Technology
By Milby
McGraw-Hill

Tool Design
by Donaldson & LeCain
McGraw-Hill

Tool Design
by Pollack
Prentice Hall

Toolmakers Handbook
by Black
Sams

Trigonometry
by Ayres
McGraw-Hill

Self-Study or Programmed Materials

Blueprint Reading for Machinists - Advanced (Self-Study)
Delmar

Electrical Fundamentals for Technicians (Programmed)
by Shrader
Gregg/McGraw-Hill

Hydraulic Principles (Programmed)
#25573-Slides & Cassette Tapes
by Hill
Sams

Jig & Fixture Design Vols. I & II (Self-Study)
Delmar

Trigonometry Self-Taught (Programmed)
by Selby
McGraw-Hill

WELDING

Textbooks

Accident Prevention Manual
by Strong
American Technical Society

Basic Arc Welding
by Griffin & Roden
Delmar

Basic Oxyacetylene Welding
by Griffin & Roden
Delmar

Basic Tig and Mig Welding
by Griffin & Roden
Delmar

Blueprint Reading for Welders
by Bennett & Sly
Delmar

Descriptive Geometry
by Hawk
McGraw-Hill

Elementary Metallurgy
by Frier
McGraw-Hill

Pipe Welding Techniques
by Griffin, Roden & Briggs
Delmar

Practical Problems in Mathematics for Welders
by Schell & Matlock
Delmar

Welding Processes
by Griffin & Roden
Delmar

Self-Study or Programmed Materials

Basic and Advanced Arc Welding (Programmed)
Westinghouse

Basic Arc Welding (Self-Study)
by Griffin & Roden
Delmar

Basic Oxyacetylene Welding (Self-Study)
by Griffin & Roden
Delmar

Basic Blueprint Reading & Sketching (Self-Study)
by Olivo & Payne
Delmar

Pipe Welding Techniques (Self-Study)
by Griffin, Roden & Briggs
Delmar

Plane Geometry (Programmed)
by Curtis
Encyclopedia Britannica

SOURCE LISTING

American Technical Society
508 Stony Island Ave.
Chicago, Illinois 60637

Theodore Audel & Co.
4300 West 62nd Street
Indianapolis, Indiana 46268

AVI Publishing Co. Inc.
P.O. Box 831-250 E. State Street
Westport, Conn. 06880

Bennett Books
809 W. Detweiller Drive
Peoria, Illinois 61614

Boobs - Merrill Educational Publishing
4300 West 62nd Street
Indianapolis, Indiana 46206

Delmar Publishers
P.O. Box 5087
Albany, New York 12205

Encyclopedia Britannica Educational Corporation
425 North Michigan Ave.
Chicago, Illinois 60611

Goodheart-Willcox Company, Inc.
123 West Taft Drive
South Holland, Illinois 60473

Hayden Book Company
50 Essex Street
Rochelle Park, New Jersey 07662

Hoffman Occupational Learning Systems
4423 Anden Drive
El Monte, California 91734

Holt, Rinehart and Winston
383 Madison Avenue
New York, New York 10017

McKnight Publishing Company
Bloomington, Illinois 61701

Prentice-Hall
Educational Book Division
Englewood Cliffs, New Jersey 07632

Reston Publishing Company
Reston, Virginia

John F. Rider Publisher
New York

Howard W. Sams & Co.
4300 West 62nd Street
Indianapolis, Indiana 46206

Westinghouse Learning Corporation
New York, New York 10017

John Wiley & Sons
605 Third Avenue
New York, New York 10016

Xerox Learning Systems
30 Buxton Farms Road
Stamford, Connecticut 06904

McGraw-HillBook Company
1221 Avenue of the Americas
New York, New York 10017

FORM 4A **FILE**

North Carolina Department of Labor
APPRENTICESHIP DIVISION

STANDARDS OF APPRENTICESHIP

Effective ____________________ the ____ will train apprentices under the following program, registered with the North Carolina Department of Labor, Apprenticeship Division.

I. Apprentices will be carefully selected from applicants between _________ and _________ years of age, whose background, education, personality and physical condition indicate they are likely to succeed. Veterans over 35 years of age shall be eligible for apprenticeship training.

The recruitment, selection, employment, and training of apprentices during their apprenticeship, shall be without discrimination because of race, color, religion, national origin, or sex. The sponsor will take affirmative action to provide equal opportunity in apprenticeship and will operate the apprenticeship program as required under Title 29 of the Code of Federal Regulations, Part 30, and equal employment opportunity regulations of the State of North Carolina.

The employer agrees that the apprentice will be worked under such conditions as will result in normal advancement; he will require the apprentice to make satisfactory progress in both on-the-job training as well as in the related and and technical studies.

II. Apprentices will be indentured and registered with the NORTH CAROLINA DEPARTMENT OF LABOR APPRENTICESHIP DIVISION and will be given regular employment as far as possible during the term of their apprenticeship. The first 500 hours will be a probationary period, during which either party may terminate the agreement by notifying the others; after this period the agreement may be terminated by either party thereto at any time. THE NORTH CAROLINA DEPARTMENT OF LABOR APPRENTICESHIP DIVISION shall be notified of all terminations and the reasons therefor. To assure proper supervision and training the company agrees to hire not more than one apprentice to each ___________ journeyman regulary employed.

III. Apprentices will be given training and work experience under the proper supervision, for a period of ________ hours (Approximately ____________ years) in the processes of the trade, as indicated on the attached "Schedule of Work Processes." They will be paid a progressive wage scale as indicated on the attached "Schedule of Wages."

Credit will be given for trade experience prior to indenture, provided the NORTH CAROLINA DEPARTMENT OF LABOR APPRENTICESHIP DIVISION be advised by a responsible company representative that the apprentice has acquired this experience, the name of the company, the trade processes engaged in and the number of hours spent in each process, together with the credit allowed. Minor variations from the schedule are permissible, provided the term of apprenticeship is not reduced, and the training of the apprentice is not interferred with.

IV. Apprentices will be required to attend classes in related instruction when arranged, for a minimum of 144 hours per year. They ______________ be paid for the time so spent. The related instruction is supplementary to their on-the-job training. Time spent in related instruction classes shall not be credited on the apprenticeship term. Credit may be given for related instruction completed before starting apprenticeship.

V. The company will designate a Supervisor of Apprentices who will arrange training under this program and keep a record thereof. He is authorized to adjust any differences with the apprentices, subject to review and determination by the company.

FORM 4B
Revised 11/16/76

VI. Each Apprentice shall be provided with the fundamental instruction required to enable him to perform his work in a safe manner. These fundamentals shall include instructions relative to pertinent company safety regulations, reporting of accidents, and availability of first aid and medical facilities. The company shall at all times exercise reasonable precaution for the health and safety of the apprentices engaged in the performance of assigned work, and shall comply with all applicable provisions of safety and health statutes and codes. The sponsor also agrees to adhere to the health and safety provisions in accordance with the North Carolina Occupational Safety and Health Act, State Statute 95-135, Senate Bill 342. (This includes every apprentice or trainee except those engaged in Atomic Energy, longshoring, railroading and federal employees. They are exempt by Senate Bill 342.)

VII. A copy of these standards and each indenture under them will be registered with the North Carolina Department of Labor, Apprenticeship Division. Upon completion of training the company will recommend to the NORTH CAROLINA DEPARTMENT OF LABOR, APPRENTICESHIP DIVISION that a Certificate of Completion be awarded the apprentice.

VIII. The apprentice's work day and work week shall be the same as the journeyman and shall be entitled to the same overtime benefits. Apprentices under 18 years of age are subject to the laws and regulations governing child labor.

IX. Training and payroll records for veterans receiving VA benefits must be retained for a minimum of three years after the training of the individual has been terminated. Sponsors will make available all training and payroll records for inspection by representative from the North Carolina Apprenticeship Division and/or Veterans Administration.

X. Veterans Administration regulations require that all training benefits cease whenever the trainee is paid an amount equal to or more than the stated journeyman rate; therefore, the sponsor must notify the NCDL Apprenticeship Division in writing when the apprentice is paid the journeyman rate.

XI. Each apprentice will be required to read these standards before entering training.

FILE

Form 11
North Carolina Department of Labor
APPRENTICESHIP DIVISION

CHECK APPROPRIATE BOX

☐ Vietnam Era Veteran
☐ Other Veteran
☐ Non-Veteran

ON-THE-JOB TRAINING AGREEMENT

County # ____________________ Program Sponsor # ____________________

SOCIAL SECURITY NUMBER

C# ____________________

The employer and trainee whose signatures appear below agree to these terms of training:

The employer agrees to conform to the schedule of training approved by the North Carolina Department of Labor, Apprenticeship Division.

The Trainee agrees to apply himself diligently and faithfully to learning the occupation in accordance with this agreement.

OCCUPATION & DOT #	TERM OF TRAINING (MONTHS)	DATE THE TRAINING BEGINS & ENDS
CREDIT FOR PREVIOUS EXPERIENCE	NORMAL WORK WEEK	PROBATIONARY PERIOD

This agreement may be terminated by mutual consent of the parties, citing cause(s), with notification to the Registration Agency.

NAME OF TRAINEE (Type or Print)	SIGNATURE OF PARENT OR GUARDIAN
SIGNATURE OF TRAINEE	DATE OF BIRTH (Month, Day, Year)
ADDRESS & ZIP CODE	CHECK APPROPRIATE BOX ☐ MALE ☐ FEMALE
NAME OF PROGRAM SPONSOR	RACE/ETHNIC GROUP: (Check one) ☐ CAUCASIAN/WHITE ☐ INFORMATION NOT AVAILABLE ☐ NEGRO/BLACK ☐ NOT ELSEWHERE CLASSIFIED ☐ ORIENTAL ☐ SPANISH AMERICAN ☐ AMERICAN INDIAN
ADDRESS & ZIP CODE	HIGHEST EDUCATION LEVEL (Check one) ☐ 8th GRADE OR LESS ☐ 9th GRADE OR MORE ☐ 12th GRADE OR MORE
SIGNATURE & TITLE OF AUTHORIZED OFFICIAL	

REGISTERED BY (Name of Registration Agency)

NORTH CAROLINA DEPARTMENT OF LABOR, APPRENTICESHIP DIVISION

SIGNATURE OF AUTHORIZED OFFICIAL	DATE

COMMISSIONER OF LABOR

FORM 9

North Carolina Department of Labor
APPRENTICESHIP DIVISION

FILE

APPRENTICESHIP AGREEMENT
Between Apprentice and Employer

County # ____________ Program Sponsor # ____________

CHECK APPROPRIATE BOX

☐ Vietnam Era Veteran
☐ Other Veteran
☐ Non-Veteran

SOCIAL SECURITY NUMBER

C# ____________

The employer and apprentice whose signatures appear below agree to these terms of apprenticeship:

The employer agrees to the nondiscriminatory selection and training of apprentices in accordance with the Equal Opportunity Standards stated in Section 30.3 of Title 29, Code of Federal Regulations, Part 30; and in accordance with the terms and conditions of the North Carolina Department of Labor, Apprenticeship Division which are made a part of this agreement.

The apprentice agrees to apply himself diligently and faithfully to learning the trade in accordance with this agreement.

TRADE AND DOT #	TERMS OF APPRENTICESHIP (Months)	DATE APPRENTICESHIP BEGINS & ENDS
CREDIT FOR PREVIOUS EXPERIENCE	NORMAL WORK WEEK	PROBATIONARY PERIOD

This agreement may be terminated by mutual consent of the parties, citing cause(s), with notification to the Registration Agency.

NAME OF APPRENTICESHIP (Type or Print)	SIGNATURE OF PARENT OR GUARDIAN
SIGNATURE OF APPRENTICE	DATE OF BIRTH (Month, Day, Year)
ADDRESS & ZIP CODE	CHECK APPROPRIATE BOX ☐ MALE ☐ FEMALE
NAME OF PROGRAM SPONSOR	RACE/ETHNIC GROUP: (Check one) ☐ CAUCASIAN/WHITE ☐ NEGRO/BLACK ☐ ORIENTAL ☐ AMERICAN INDIAN ☐ INFORMATION NOT AVAILABLE ☐ NOT ELSEWHERE CLASSIFIED ☐ SPANISH AMERICAN
ADDRESS & ZIP CODE	HIGHEST EDUCATION LEVEL (Check one) ☐ 8th GRADE OR LESS ☐ 9th GRADE OR MORE ☐ 12th GRADE OR MORE

SIGNATURE & TITLE OF AUTHORIZED OFFICIAL

APPROVED BY (Joint Apprenticeship Committee)

SIGNATURE OF CHAIRMAN OR SECRETARY — DATE

REGISTERED BY (Name of Registration Agency)
NORTH CAROLINA DEPARTMENT OF LABOR, APPRENTICESHIP DIVISION

SIGNATURE OF AUTHORIZED OFFICIAL — DATE

COMMISSIONER OF LABOR

Form 10
North Carolina Department of Labor
APPRENTICESHIP DIVISION

FILE

APPRENTICESHIP AGREEMENT
Between
Apprentice and Joint Apprenticeship Committee

CHECK APPROPRIATE BOX
☐ Vietnam Era Veteran
☐ Other Veteran
☐ Non-Veteran

SOCIAL SECURITY NUMBER

COUNTY # ____________________ PROGRAM SPONSOR # ____________________

C # ____________________

THIS AGREEMENT, entered into this ____________________ day of ____________________ 19 ______

between the parties to (Name of local apprenticeship standards) ____

____

represented by the Joint Apprenticeship Committee, hereinafter referred to as the COMMITTEE, and (Name of apprentice) ____, born (Month, Day, Year) ____________________

hereinafter referred to as the APPRENTICE, and (if a minor) (Name of parent or guardian) ____________________

________________________ hereinafter referred to as his GUARDIAN.

WITNESSETH THAT:

The Committee agrees to be responsible for the selection, placement, and training of said apprentice in the trade of ____ as work is available, and in consideration said apprentice agrees diligently and faithfully to perform the work of said trade during the period of apprenticeship, in accordance with the regulations of the Committee. The apprenticeship standards referred to herein are hereby incorporated in and made a part of this agreement.

TERM OF APPRENTICESHIP	PROBATIONARY PERIOD	CREDIT FOR PREVIOUS TRADE EXPERIENCE	TERM REMAINING

CREDIT FOR RELATED INSTRUCTION

This agreement may be terminated by mutual consent of the signatory parties, upon proper notification to the registration agency.

SIGNATURE OF APPRENTICE	TO BE COMPLETED BY THE APPRENTICE Check One: ☐ MALE ☐ FEMALE
ADDRESS (Number, Street, City, State, ZIP Code)	RACE/ETHNIC GROUP: (Check one) ☐ CAUCASIAN/WHITE ☐ NEGRO/BLACK ☐ ORIENTAL ☐ AMERICAN INDIAN ☐ INFORMATION NOT AVAILABLE ☐ SPANISH AMERICAN ☐ OTHER
PARENT OR GUARDIAN (Signature)	
SIGNATURE (Joint Apprenticeship Committee, Chairman)	HIGHEST EDUCATION LEVEL: (Check one) ☐ 8th GRADE OR LESS ☐ 9th GRADE OR LESS ☐ 12th GRADE OR MORE
SIGNATURE (Joint Apprenticeship Committee, Secretary)	

NAME OF REGISTRATION AGENCY
NORTH CAROLINA DEPARTMENT OF LABOR, APPRENTICESHIP DIVISION

DATE (Month, Day, Year)	SIGNATURE AND TITLE OF AUTHORIZED OFFICIAL

FORM 12
North Carolina Department of Labor
APPRENTICESHIP DIVISION

FILE

APPRENTICESHIP AGREEMENT
Between
Apprentice and Not Joint Apprenticeship Committee

☐ Vietnam Era Veteran
☐ Other Veteran
☐ Non-Veteran

SOCIAL SECURITY NUMBER

COUNTY # ________________ PROGRAM SPONSOR # ________________

C # ________________

THIS AGREEMENT, entered into this ________________ day of ________________ 19____

between the parties to (Name of local apprenticeship standards) ________________________________

____

represented by the Not Joint Apprenticeship Committee, hereinafter referred to as the COMMITTEE, and (Name of apprentice)

________________________________, born (Month, Day, Year) ________________

hereinafter referred to as the APPRENTICE, and (if a minor) (Name of parent or guardian) ________________

________________ hereinafter referred to as his GUARDIAN.

WITNESSETH THAT:

The Committee agrees to be responsible for the selection, placement and training of said apprentice in the trade of ________________ ________________ as work is available, and in consideration said apprentice agrees diligently and faithfully to perform the work of said trade during the period of apprenticeship, in accordance with the regulations of the Committee. The apprenticeship standards referred to herein are hereby incorporated in and made a part of this agreement.

TERM OF APPRENTICESHIP	PROBATIONARY PERIOD	CREDIT FOR PREVIOUS TRADE EXPERIENCE	TERM REMAINING

CREDIT FOR RELATED INSTRUCTION

This agreement may be terminated by mutual consent of the signatory parties, upon proper notification to the registration agency.

SIGNATURE OF APPRENTICE

ADDRESS (Number, Street, City, State, ZIP Code)

PARENT OR GUARDIAN (Signature)

SIGNATURE (Not Joint Apprenticeship Committee, Chairman)

SIGNATURE (Not Joint Apprenticeship Committee, Secretary)

TO BE COMPLETED BY THE APPRENTICE

Check One: ☐ MALE ☐ FEMALE

RACE/ETHNIC GROUP: (Check one)

☐ CAUCASIAN/WHITE
☐ NEGRO/BLACK
☐ ORIENTAL
☐ AMERICAN INDIAN
☐ INFORMATION NOT AVAILABLE
☐ NOT ELSEWHERE CLASSIFIED
☐ SPANISH AMERICAN

HIGHEST EDUCATION LEVEL: (Check one)

☐ 8th GRADE OR LESS
☐ 9th GRADE OR MORE
☐ 12 GRADE OR MORE

NAME OF REGISTRATION AGENCY
NORTH CAROLINA DEPARTMENT OF LABOR, APPRENTICESHIP DIVISION

DATE (Month, Day, Year)

SIGNATURE AND TITLE OF AUTHORIZED OFFICIAL

Form 8
North Carolina Department of Labor
APPRENTICESHIP DIVISION

FILE

STATEMENT OF ASSURANCE OF COMPLANCE WITH TITLE VI, CIVIL RIGHTS ACT OF 1964

____ (hereinafter called the "Signatory")
(Name of Organization, Facility, School, or Training Establishment)

HEREBY AGREES THAT

it will comply with Title VI of the Civil Rights Act of 1964 (PL 88-352) and all regulations adopted pursuant to such Title VI, for instance, VA Regulations (38 CFR Part 18), to the end that no person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under any program or activity of the Signatory receiving Federal financial assistance or other benefits under statutes administered by the VA or by other Federal agencies, either directly, or indirectly through benefits paid to a student or trainee because of enrollment in an educational program of the Signatory; and HEREBY GIVES ASSURANCE THAT it will immediately take any measures necessary to effectuate this agreement.

If any real property or structure thereon is provided or improved with the aid of Federal financial assistance extended to the Signatory by the VA, this assurance shall obligate the Signatory, or in the case of transfer of such property, any transferee, for the period during which the real property or structure is used for a purpose for which the Federal financial assistance is extended or for another purpose involving the provision of similar services or benefits. In all cases this assurance shall obligate the Signatory for the period during which the Federal financial assistance is extended to any of its programs by the VA or by any other Federal agency.

THIS ASSURANCE is given in consideration of and for the purpose of obtaining Federal financal assistance, including facilities furnished or payments made under sections 641, 3402(a)(2), 5031-5037, 5055, and chapters 31, 34, 35, and 36 of Title 38, U.S.C.

The Signatory recognizes and agrees that such Federal financial assistance or other benefits will be extended in reliance on the representations and agreements made in this assurance, and that the VA will withhold financial assistance, facilities, or other benefits to insure fulfillment of this assurance of compliance, and that the United States shall have the right to seek judicial enforcement of this assurance. This assurance is binding on the Signatory, its successors, transferees, and assignees. The person or persons whose signatures appear below are authorized to sign this assurance.

____
(Date)

____
(Signature of president or other authorized official)

____

____
(Title)

____
(Mailing address)

FORM 5A **FILE**

North Carolina Department of Labor
APPRENTICESHIP DIVISION

ON-THE-JOB TRAINING APPROVAL

Effective ---------------------- the ----------------------------------- will provide On-the-Job Training under the following program registered with the Department of Labor, Apprenticeship Division.

I. The training content of the course is adequate to qualify the eligible veteran for appointment to the job for which he is to be trained. (See attached Schedule of Training.)

II. There is reasonable certainty that the job for which the eligible veteran is to be trained will be available to him in the establishment at the end of the training period.

III. The job is one in which progression and appointment to the next higher classification are based upon skills learned through organized training on the job and not on such factors as length of service and normal turn-over.

IV. The wages to be paid the eligible veterans upon entrance into training, are not less than wages paid non-veterans in the same training position and are at least 50 percent of the wages paid for the job for which he is to be trained, and such wages will be increased in regularly periodic increments until, nor later than the last full month of the training period, they will be at least 85 percent of the wages paid for the job for which such eligible veteran is being trained.

V. The job customarily requires a period of training of not less than six months and not more than two years of full-time training.

VI. The length of the training period is no longer than that customarily required by the training establishment and other training establishments in the community to provide an eligible veteran with the required skills. Arrangements must be made for the acquiring of job knowledge, technical information, and other facts which the eligible veteran will need to learn in order to become competent on the job for which he is being trained. (See Schedule of Training for length of training period.)

VII. Provision is made for related instruction for the individual eligible veteran who may need it. Related instruction is to be determined on an individual basis. A trainee may be given credit for related instruction completed prior to entry.

VIII. There is in the training establishment adequate space, equipment, instructional material and instructor personnel to provide satisfactory training on the job. In no case shall approval be given for more than one trainee to each journeyman or experienced person regularly employed in each occupation. The trainee shall be under the direct supervision of a journeyman or experienced person on the job. The degree of supervision depends on the work location, work being performed and the skills of the trainee; however, the trainee must be under the direct supervision of a journeyman or experienced person on the job at all times while performing work of his trade or occupation.

IX. Adequate records are to be kept to show the progress made by each eligible veteran toward his job objective. (Conduct and training record forms will be provided by the NCAC.) Appropriate credit is to be given the eligible veteran for previous training and job experience, whether in the military service or elsewhere, his beginning wage adjusted to the level to which such credit advances him and his training period shortened accordingly and provision is made for certification by the training establishment that such credit has been granted and the beginning wage adjusted accordingly. No course of training will be considered bona fide if given to an eligible veteran who is already qualified by training and experience for the job objective.

FORM 5 B
Revised 11/16/76

XI. Upon successful completion of the course of training furnished by the training establishment, the eligible veteran will be awarded a Certification of Completion of On-the-job Training by the North Carolina Department of Labor Apprenticeship Division. The employer will furnish a letter to the NCAC recommending that the applicable Certificate be issued to the Veteran. The Cetificate will be signed by the Employer, N.C. Commissioner of Labor and the Director of Apprenticeship.

XII. The program sponsor will maintain all records including payroll records pertaining to the training of veterans for a minimum of three years after the training has terminated. The record will be made available to representatives of the North Carolina Apprenticeship Division and the Veterans Administration for periodic review.

XIII. The trainee's work day and work week shall be the same as the journeyman and shall be subject to the same overtime requirements, except in cases when the trainee is under 18 years of age, in which instance the apprentice's or trainee's work day and work week must conform with the North Carolina Child Labor Regulations. The trainee shall receive credit for actual hours worked during his term of apprenticeship or training.

XIV. Veterans Administration regulations require that all training benefits cease whenever the trainee is paid an amount equal to or more than the stated journeyman rate; therefore, the sponsor must notify the NCDL Apprenticeship Division in writing when the trainee is paid the journeyman rate.

XV. That the course meets such other criteria as may be established by the Department of Labor Apprenticeship Division.

FORM 3
North Carolina Department of Labor
APPRENTICESHIP DIVISION

FILE
ON-THE-JOB TRAINING OR APPRENTICESHIP REPORT FORM

Request for (Check where applicable)
1 ☐ Registration
2 ☐ Revision
3 ☐ Cancellation

4 Original Registration Date

5 Type of Program (Check where applicable)
☐ Group Joint
☐ Individual Joint
☐ Group Waiver
☐ Individual Waiver
☐ Group not Joint
☐ Individual not Joint

6 Revision Date

7 Cancellation Date

8 (Name of Program)

9 (City, or Area of Operating Headquarters)
10 Zip
11 (County of Operating Headquarters)
12 State

13 (Registration Number)
14 (Number of Establishments, if Group Program)
15 (Total Workers, if Individual Program)

16 (Principal Products, or Services, if Individual Program)
17 (Bargaining Agency, whether or not Signatory)

18 SIC Code

	19 Trade or Craft (as given in standards)	20 Comparable Trade Title	21 Term	22 No. of Jr.	23 Quota of Apprentices
A					
B					
C					
D					
E					

24 Provide here complete apprentice wage schedule (Wage rate by percentage unless otherwise indicated)

Trade or Craft	Journeyman Rate	Interval	PERIOD AND RATE											
			1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th
A														
B														
C														
D														
E														

25 (Effective Date)
26 (Normal Work Week)
27 (Ratio)

28 (If Participant in a Committee, list Name of Committee)
29 If Group Program
☐ Committee Indenture ☐ Company Indenture

30 Remarks

UNIVERSITY OF CALIF.
LOS ANGELES

MAR 4 1977

31 (Apprenticeship Representative Reporting)
32 (Date of Report)

CLEARINGHOUSE FOR
JUNIOR COLLEGES